Railway Mechanical Engineer

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Realizing the importance of the part which the air brake plays in the operation of the modern railroad and in response to the wishes expressed by a number of our readers, we have started in this issue a department called the "Air Brake Corner" where answers will be given to questions together with general news of the air brake field. If this department develops as anticipated, it will soon be necessary to allot considerably more space and assign a broader title. Brake matters will not be confined to this department, however, as articles of general interest, such as the one in this issue on the recent vacuum brake tests in England, will appear in other parts of the paper.

For the Air Brake Man

According to the latest published statistics of the Interstate Commerce Commission there are approximately 68,000 steam locomotives operating in the United States and, assuming an average of 230 boiler tubes to each locomotive, the total number of tubes installed is about 16,000,000. These tubes pit, corrode, accumulate scale and in other ways become unfit for service, requiring frequent replacement. Even if this were not true, all boiler tubes would have to be removed, inspected and reapplied at least once in every four years in accordance with a ruling of the Interstate Commerce Commission. In other words, 25 per cent at the least calculation, of 16,000,000 locomotive boiler tubes (the proportion is probably twice that) must be removed annually, which gives some idea of the magnitude and importance of the problem of boiler tube installation and maintenance. An unusually valuable article on this subject is published in this issue (page 221), the authors describing the results of an extended comparison and checking of the boiler tube maintenance practice on over 30 railroads. Eliminating the unnecessary and keeping the best has resulted in the practice described which has been checked by one of the largest railroad systems in the country and qualifies as an approved standard practice. The article is published in two installments, the first of which appears in this issue and pertains to methods and tools for installing locomotive boiler tubes, superheater flues and arch tubes. A later installment will relate to safe-ending, welding and maintaining tubes tight under varying service conditions. A part of the later installment will also be devoted to shop layouts and service records.

Boiler Tube Maintenance

One of the remaining evidences of the loss of morale with which the mechanical department has been so seriously handicapped during the past few years, is a laxity on the part of many foremen in the exercise of one of their most important functions. With the administration of discipline so largely removed from their hands during Railroad Administration control, it is not surprising that foremen were loath to examine too closely into the extent to which their instructions were carried out. At the present time, however, after a large measure of improvement has been effected in labor efficiency, it is still evident that many foremen are neglecting the part of their duties which is of even greater importance than the issuing of instructions, that is, to know and insist that they have been carried out effectively. The effect of laxity in the performance of this important duty is probably more marked in the roundhouse than in the shop, where the forces are more highly organized and the work more closely follows a well established routine. In the roundhouse it depends entirely on the foreman whether the efforts of the forces are to be spent effectively or are to be wasted. In many cases large additional expense is being incurred through repeatedly but ineffectively attempting to correct conditions which keep recurring on the work reports, that would soon be eliminated through the simple process of conscientiously checking the work after it has been performed. So long as the foreman is satisfied just to "get by" the men cannot be expected to put forth their efforts to maintain any higher standard. The ability of a foreman cannot be judged primarily by the way in which his work is assigned. A reasonably intelligent call boy could probably perform this part of the foreman's duties successfully since it can be largely reduced to a matter of routine procedure. The real test of the foreman's ability lies in the effectiveness of the results obtained from the labor and material expended under his direction.

A Prime Duty of the Foreman

Long wheelbases and short radius curves result in the rapid wear of locomotive driving wheel flanges, causing one of the most troublesome maintenance problems in the mechanical department. Locomotives out of the shop less than four months often begin to cut flanges and in a short time the tires must be turned at a considerable expense, locomotives being held out of service in the meantime. On the page devoted to communications is an interesting letter to the editor on this subject, discussing the building up of worn flanges by gas welding. Doubtless important economies can be effected by this method provided it has no harmful effects in weakening the tires. The letter explains how one road has been building up sharp flanges with gas welding for about two years without a single defective flange developing. Other roads perform this same operation, but with electric welding, securing a greatly increased total service mileage from tires. It seems probable that changes in the structure of the tire steel are more localized with electric than with gas welding, but on the other hand the temperature at the point where the material is added is higher. There are those who claim that any such heating of tires changes the structure of the steel and is therefore dangerous. S. W. Miller, on page 104 of the February, 1918, *Railway Mechanical Engineer*, describes the results of extensive experiments indicating that without subsequent heat treatment to bring tire steel back to

Building Up Sharp Flanges

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its normal state, any method of fusion welding applied to steel tire changes their physical properties and is dangerous. If the process of building up sharp flanges by fusion welding is safe, it presents great possibilities of economy, particularly where one tire of a set, almost down to the thickness limit, has a sharp flange. In view of the conflicting opinions and practices, the subject of building up sharp flanges by welding is apparently one which should come before the American Railway Association for careful consideration and report.

Buying vs. Making

Among the great number of small parts utilized in repairing cars and locomotives are many which should be purchased or made locally depending upon the relative costs. The question of "Buying vs. Making" is an important one as often large amounts of money are involved and, in any specific case, an intelligent decision is dependent on accurate knowledge of detailed costs. It must also be remembered that a decision once made is by no means final, as manufacturers' quotations change from time to time and shop costs are subject to variation. This point is strongly emphasized in an article entitled "Making Washers from Old Flues" published in this issue. The author explains in the article how common washers up to 7/8 in. in diameter can be punched, two at a time, from flattened scrap boiler flues at a cost of $2.075 per 100 lb. including labor, material and overhead charges. Obviously at that figure it was a good paying proposition to manufacture washers in local repair shops during 1919 and 1920 when the manufacturer's price averaged $5.425 per 100 lb. In July, 1921, this price dropped to $1.84 when it was no longer profitable to make the washers locally but cheaper to buy them. Had an accurate knowledge of shop costs not been available, the railroad in question might have continued the practice of making its own washers at an ever-increasing loss. Owing to marked changes in prices during the past year it will probably pay all railroads to check their present costs of both manufacturing and reclamation work to make sure that maximum economy is being secured.

Another important point brought out in the article is that while the work of punching washers requires no special skill and could be performed by a laborer as well as a mechanic, the higher priced man must be employed according to present rules. If laborers could be used on this class of work the labor charge would be reduced and the railroad could still afford to make its own washers with an appreciable saving in cost. This is but another example of the way in which certain standardized rules still handicap the railroads, increase their cost of operation, and cause unemployment among railroad workers.

What Is a Fair Wage?

REPRESENTATIVES of the railroads and the labor organizations are once more engaged in presenting arguments before the Labor Board on the question of wages for the shop crafts. The railroads have introduced testimony to show that the wages of railroad shop employees are higher in proportion to the cost of living than before the war and also considerably higher than are paid to men doing comparable work in other industries. In reply to these statements, B. M. Jewell, representing the unions, contended that the railroads should pay a wage sufficient to maintain an average family of five according to a "healthful standard of living."

The reduction of wages is never a pleasant subject and the statement that workers cannot support a family on the wages they are receiving, is entitled to sympathetic consideration. In justice to all concerned, it is necessary to consider carefully whether the railroads could, or whether they should pay the wage advocated by Mr. Jewell.

The budget for a family of five which Mr. Jewell proposed amounts to $2,637 a year and to secure this amount he stated that railway mechanics must earn 40 per cent more than they are now being paid. The question at once arises whether the railroads could afford to increase wages to such an extent.

It goes without saying that other employees are just as much entitled to a healthful standard of living as the shop crafts. The railroads at present have about 1,700,000 employees. An average wage of $2,637 would make the railway payroll over $4,500,000,000 a year, which is about $1,700,000,000 more than in 1921. If the railroads had paid this sum for wages last year and all other expenses had been the same, their expenses and taxes would have been $1,000,000,000 greater than their earnings without paying a cent for interest or dividends.

Mr. Jewell did not explain where the railroads were to get the additional $1,700,000,000 to pay these higher wages, but he intimated that the railroads pay excessive prices to supply companies and if the railroads paid lower prices, they could pay higher wages. In 1920, the railroads paid for fuel and other material and supplies $1,736,000,000 and in 1921 the cost was, of course, considerably lower, although figures are not available. If the supply companies were to cut prices so that the railroads could save even $1,000,000,000, it would certainly be necessary for the manufacturing concerns to reduce wages very greatly. It should be remembered, however, that wages in outside industries are already lower than the rates paid on the railroads. Furthermore, if railroad workers are entitled to an average wage of $2,637, why should not the same apply to workers in other industries?

The crux of the whole matter is the ability of the railroads and industry in general to pay the wage proposed. An investigation of the total production and income of the people of the United States showed that the production and income reached its maximum in 1919 when it was $66,000,000,000. The total number of persons "gainfully employed" in this country is about 42,000,000 and to provide the average income Mr. Jewell suggests would require an aggregate annual income of $111,000,000,000. It would be impossible to pay the average wage that Mr. Jewell proposes unless the production of the country was nearly doubled.

It is worth while to investigate some of the figures used by Mr. Jewell in arriving at his conclusion. It is assumed that the average family consists of five persons, but the records of the census show the average family contains 4.3 persons. The average family is not supported by the earnings of one person as the census again shows the average number of workers in each family to be 1¾. It would require an average individual income of $1,510 a year to give an average family income of $2,637. From this it is evident that present wage rates are not badly out of line. As a matter of fact, since the wages of railway workers are higher in relation to the cost of living than before the war, they represent a preferred class. Consider, for example, the incomes and expenses of farmers. In 1914 agricultural implements could be bought for the price the farmer received for 100 bushels of corn. In March, 1922, the farmer had to sell 274 bushels of corn to buy the same machine. The farmer is just as much entitled to fair dealing as the railroad worker and a readjustment of wages and prices is needed to improve his situation. One of the changes that will better conditions is a reduction in freight rates and the only way this can be accomplished seems to be by a fair reduction in wages. What this country as a whole needs is a restoration of better business conditions. Reduced freight rates would no doubt help to bring this about and railroad employees would benefit along with everyone else.

An Intimate Chat with the Editor

THIS is your paper! We are your representatives, or trustees, whose privilege it is to try to make the *Railway Mechanical Engineer* of the greatest possible practical value to each one of its subscribers.

During recent weeks many of you have written to me, and not a few of you have made some splendid suggestions as to how we can serve you more effectively.

Several, for instance, suggested that we could make the paper of greater value to them by incorporating a Questions and Answers Column; others intimated that they liked to see crisp and newsy letters from our readers on important topics and problems; still others criticised us because some of our articles have described practices and methods which in their opinion were not nearly as good as the ones used on their roads, or in their shops.

This is fine.

We quietly tried to start a Questions and Answers Department a little while ago, but you didn't bite—didn't even nibble. If you really want such a column, send in your questions. We will either answer them to the best of our ability or else print them and invite our readers at large to send in the answers.

We would like nothing better than to have you send in a letter for publication on some live mechanical department question. Obviously we can hardly be expected to write letters to ourselves, although we have sometimes been sorely tempted to do so, to use them as bait to get you started. We want our publication to be a clearing-house for all the good things in the mechanical department. If some of you will start the ball rolling, others will undoubtedly join in and we will all benefit from the exchange of ideas and experiences. Who will be the first?

Now as to some of the articles which may have described practices not as good as those on your own road or in your own shop. You are not a good sport, if you see anything of that sort and let it get by without bringing it to our attention. No man is a friend of ours who will let a mis-statement or a poor article go by unchallenged. I wish somehow or other I could vitalize these printed words so that you would realize clearly that calling attention to our shortcomings will be considered a friendly act. And we want you to be friends—not just subscribers.

How about it?

Sincerely,

Roy V. Wright

NEW BOOKS

LIFE OF GEORGE WESTINGHOUSE. *By Henry G. Prout, C. E., A. M., LL. D., 375 pages. Portrait frontispiece and eight other illustrations. Size 6 in. x 9 in. Bound in cloth. Charles Scribner's Sons, New York.*

George Westinghouse was a great man. He was a genius, but a good deal more than that. He developed his own and others' inventions and was a business executive as well as an engineer. Above all this he was a gentleman. His pre-eminence as a noble citizen is indicated by the very lines of his portrait, and readers of this book who are unacquainted with his career will be charmed to see how the varied acts of his life confirm the impressions which they will gain from this picture.

Colonel Prout is not only a scholar, he is one of the most accomplished writers in the field of engineering, and a discriminating observer. Adding to this his own acquaintance with many of the topics dealt with, and his years of association with Westinghouse himself, one may reasonably expect a thoroughly illuminating narrative. This expectation is not disappointed. The reading public is fortunate in having the benefit of such an unusual combination.

Railroad men who shortsightedly have thought that the fame of Westinghouse rested on the air brake alone will find this book an eye-opener. The air brake was, indeed, the great outstanding mechanical feature in the railroad world from 1869 to 1889, and that alone served to put Westinghouse's name alongside of Stephenson's; but Westinghouse had a great career after that. The biographer classes his work in developing alternating electric current for the manufacture of power as at least of equal importance. In other fields—natural gas, friction draft gear, electric traction, turbo-generator and electro pneumatic apparatus for signaling—Westinghouse did a prodigious amount of pioneer work.

The candor of the author is always in evidence, and the great things which glorified the name of Westinghouse from a hundred different angles are not allowed to obscure the truth necessary to make an honest narrative. Mistakes and reverses are recognized with fidelity. Another point calling for frank treatment was the question of recognizing the work of the "large group of able, loyal and devoted assistants which Westinghouse attached to himself," these including brilliant and constructive organizers, administrators, executives and engineers. Of these a few exceptional names are mentioned, but as regards the list as a whole "the committee (mentioned below) and the editor regret that it is not practicable to enter upon the delicate task of telling what these men did."

The American Society of Mechanical Engineers is primarily responsible for this book, Messrs. Scribner working in co-operation with a committee of the society, of which Charles A. Terry was chairman. The author also gives, in the preface, the names of 18 other men who contributed material and advice; in short he has employed all the resources of the experienced editor, with a purpose of making a book of which every paragraph should be faultless.

The titles of some of the chapters are: the air brake; friction draft gear; a general sketch of electric activities, the induction motor and meter; rotary converter; the Chicago World's Fair; Niagara Falls; electric traction; steam and gas engines; the turbo-generator; signaling and interlocking; natural gas; various interests and activities; European enterprises; financial methods, etc. The lighting of the World's Fair at Chicago, in 1893, and the epoch-making work at Niagara Falls in 1889, and the following years—where now there are hydro-electric plants with an aggregate capacity of 500,000 h.p.—are among the most absorbing stories in the book.

In an appendix devoted to some description of the numerous patents taken out by Westinghouse, eight pages are required for a simple index, one line to each patent. In 11 years, from his 34th year to the end of his 44th, Westinghouse took out 134 patents, an average of more than one each month; and at the same time he was stimulating and directing the work of many other inventors. Another list, filling two pages—a single line to each item—gives the names of the Westinghouse associated companies, chronologically arranged.

PROCEEDINGS OF THE TRAVELING ENGINEERS' ASSOCIATION. *207 pages, 6 in. by 8½ in., bound in leather. Published by the association, W. O. Thompson, secretary, 1177 East Ninety-eighth street, Cleveland, Ohio.*

This is the official report of the Twenty-ninth Annual Meeting of the Traveling Engineers' Association, held in Chicago, September, 1921. The subjects of the papers presented and discussed were: Distribution of power and effects on operating costs; recommended practice for conservation of locomotive appurtenances and supplies; advantages of self-adjusting wedges, feed water heaters and boosters; best method of operating stoker-fired locomotives; comprehensive standard method of employing, educating and examining engineers; operation and maintenance of oil-burning locomotives.

MILLING CUTTERS AND MILLING. *69 pages, 5 in. by 8 in., illustrated, bound in leather. Published by the National Twist Drill & Tool Company, Detroit, Mich.*

In view of the increasing use of milling machines in railroad machine shops this book will be of special interest. It explains in simple terms the fundamental principles of milling with particular emphasis on the effects of rake, clearance and spiral, shape of teeth, chip space, number of teeth, feeds, cutting speeds, lubrication and cooling. Much of this material is presented as a result of experiments conducted during the past two years at the University of Michigan by Professor John Airey of the University of Michigan and Karl J. Oxford, chief engineer of the National Twist Drill & Tool Company, Detroit, Mich. Early in the book there is a chapter devoted to a comparison of milling with turning and planing. The last three chapters are devoted to the milling machine as related to the milling cutter, the care of milling cutters and various types of milling cutters and their uses.

USE OF SOUTHERN YELLOW PINE IN CAR CONSTRUCTION. *By H. S. Sackett. 55 pages, 6 in. by 9 in., illustrated. Published by Southern Pine Association, New Orleans, La.*

This booklet will be of interest to and should be in the hands of all those who have to do with the design, operation or maintenance of wooden or composite railway cars. The book is well illustrated and is filled with much valuable information and many good suggestions. A considerable portion of the subject matter is applicable not only to yellow pine lumber but also to other woods.

The book is divided into four parts. Part one outlines railroad car development from the early beginning of a century ago. Particular attention is given to the use of wood in freight car construction and the advantages of the composite design. Box, gondola, stock and refrigerator cars are discussed separately. Part two treats of the methods for storing and handling or the care and protection which should be given to prevent decay and guard against fires. Part three deals with preservative treatments, offers practical suggestions, and suggests an extension of the practice. Part four is devoted to the properties of southern yellow pine and contains a number of tables relative to mechanical properties, hardness, strength, weight, recommended working stresses, etc., which add to the value of the book for reference purposes.

Walschaert Valve Gear with Variable Lead

Modifications Secure Ample Lead While Running Combined with No Lead When Starting

VARIOUS methods have at times been used to provide variable lead for the Walschaert valve gear, such as increasing the width of the link slot at each end to eliminate lead at starting, gradually increasing it as the running position was reached. With this method it was found that because of the balanced condition of the valve, the lost motion in the link would allow the link block to move over to the wrong side of the link and increase the lead. It was also found that starting an engine out of the shop with lost motion in the link caused wear throughout the entire motion. Another method tried was the adjustment of the eccentric crank, and while this provided for a variable lead in the forward motion, it was objectionable in that it distorted the back-up motion.

With a view of providing a variable lead that would insure a better steam distribution and at the same time not distort the valve motion in either direction nor cause rapid wear of motion work, the valve gear shown in the photograph and drawing was developed and patented by J. O. Jones, supervisor of valve motion, Chicago, Milwaukee & St. Paul, Milwaukee, Wis. By means of this modification of the Walschaert valve gear a variable lead is substituted for the constant lead which is characteristic of the standard design of gear.

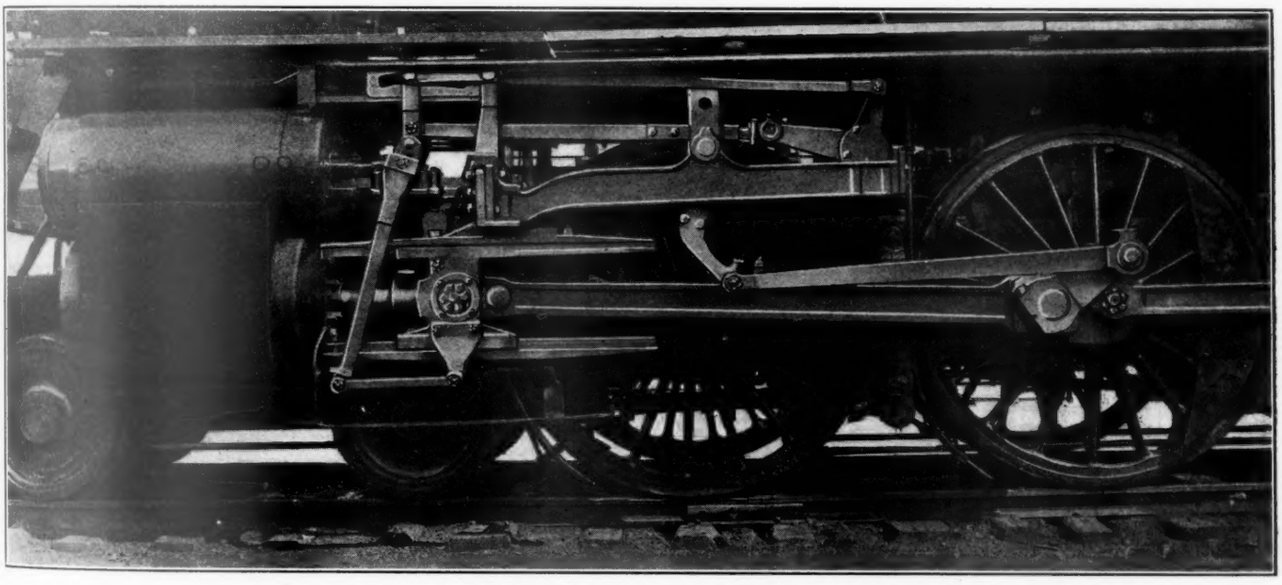


Fig. 1—Application of Jones Variable Lead Gear on Chicago, Milwaukee & St. Paul

An engine is given lead primarily to insure that full steam pressure will be exerted on the piston when it passes the dead center and starts on its working stroke. In order that this may be done it is necessary, due to wire-drawing of the steam at small openings, that the steam valve starts to open slightly in advance of the dead center. Lead is a disadvantage when starting but after the engine has started lead is a decided advantage, for in addition to providing full pressure on the piston at the beginning of the stroke, it also assists compression in cushioning the reciprocating parts as they come to rest at the dead center.

The Walschaert gear is a constant lead gear because the proportions of the combination lever remain fixed. If by some means these proportions could be varied, the lead could be varied. This is what is done in the Jones gear. The normal connection of the combination lever to the valve cross head is by means of a pin. In the Jones gear this permanent connection is changed to a movable one, made by putting an oblong slot in the combination lever and providing a block to slide in the slot, this block being fastened to the valve stem crosshead by a pin. By raising or lowering the combination lever, its proportions can then be changed as desired.

Description of Mechanism

To provide no lead in starting it is necessary to have the combination lever move the valve only twice the lap in full gear, the movement being increased as the cutoff is shortened. The mechanism which is used for this purpose is shown in Fig. 2. A cam *A* which contains a curved slot and is placed in guides, is attached to the reversing shaft of the engine by means of a reach rod *D* and lever arm *H*. The follower of the cam is attached to the upper end of the combination lever *G* by means of a link *E* and to the guide support by means of a tie *C*. The radius rod *F* is connected to the link *E* instead of to the top of the combination lever *G* as is done in the standard Walschaert gear.

As a result of these modifications, when the reverse lever is moved from the central position to either corner, the combination lever is lowered and the proportion of that part of the combination lever between the connection to the radius rod and the connection to the valve stem to the whole lever is decreased and consequently the motion of the valve due to the combination lever is decreased. As the reverse lever is hooked up the combination lever is raised and the amount of movement imparted to the valve from this source is increased. The limits of the change in the movement of the valve as received through the combination lever, are from

twice the lap in the corner notch, to twice the sum of the lap and lead in the center notch.

By connecting the radius rod *F* to the link *C* instead of directly to the combination lever *G*, another feature is secured which tends to improve the starting qualities of the locomotive. Thus with the same link, radius rod and eccentric crank as is used on a standard Walschaert geared engine, by connecting the radius rod as shown, a longer valve travel will result. This causes cut-off and compression to occur later in the stroke, which results in an increased mean effective pressure. The valve action is moreover quicker since in the same relative time the valve travels a greater distance.

A valve gear as above described was applied to a Chicago, Milwaukee & St. Paul locomotive of the Pacific type, No. 6115, on June 16, 1921, and has made 40,000 miles in passenger service between Milwaukee and Chicago, a distance of 85 miles, handling a train of ten steel cars weighing 750 tons one way, and a return trip with from seven to ten cars, making nine station stops, in a running time of two hours and ten minutes.

The locomotive is performing very satisfactorily; the benefit of the new valve arrangement at starting, due to taking away the resistance caused by lead in full cut-off, is noticeable, while the 1/16 in. increased lead in running notches over that obtained from the original gear provides more speed when hooked up. Sample indicator cars are shown of locomotive 6115 equipped with the Jones gear and of locomotive 6116 equipped with the regular Walschaert gear. These two locomotives are identical in all particulars except that of valve gear.

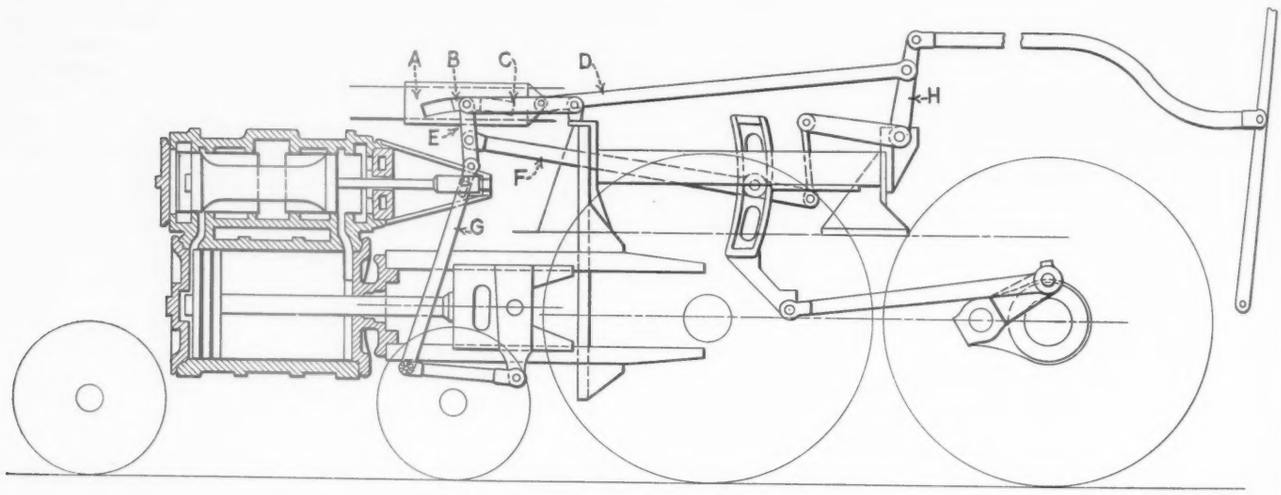


Fig. 2—Diagram of Jones Variable Lead Gear

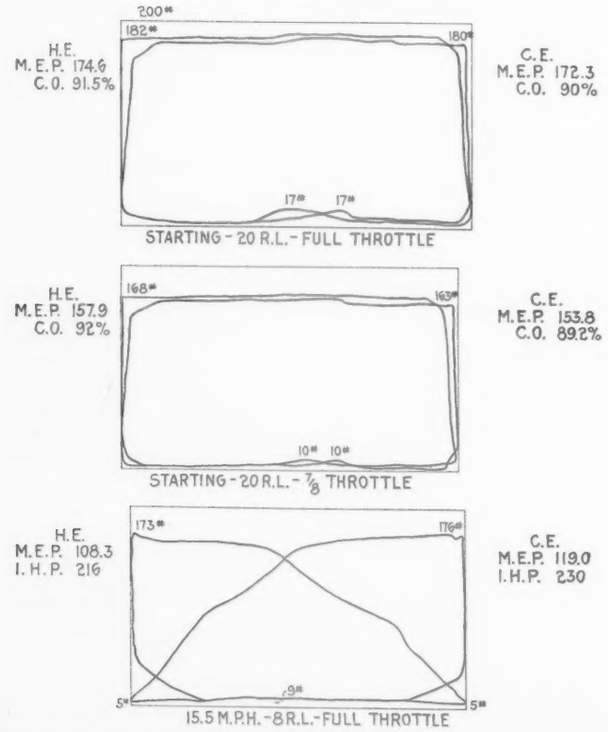


Fig. 3—Indicator Cards from Locomotive 6115 with Jones Variable Lead Gear

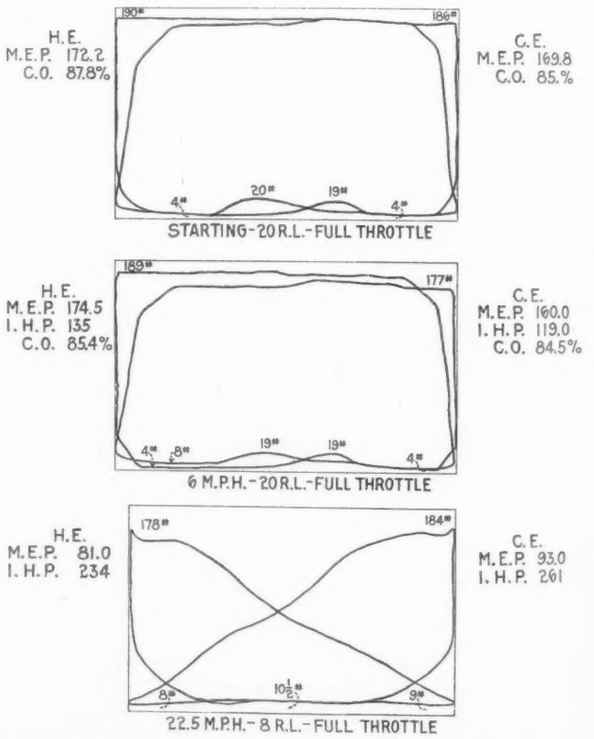
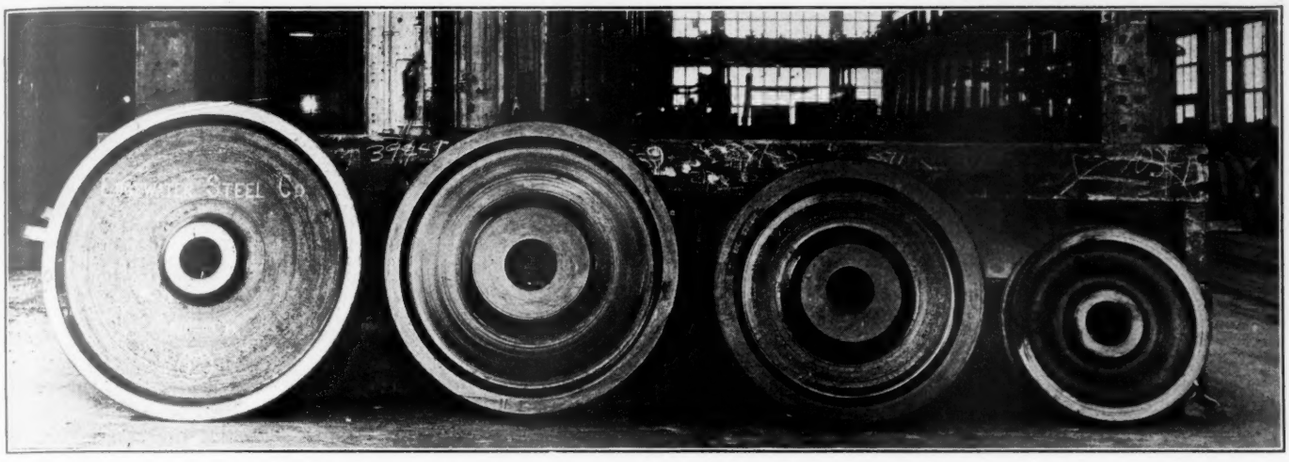


Fig. 4—Indicator Cards from Locomotives 6116 with Regular Walschaert Gear



Four Sizes of Wheels Rolled on the Same Mill; Right to Left, a 33 in. Freight Car Wheel, 44 in. and 50 in. Trailer Wheels and a 53 in. Special Wheel

Rolled Steel Trailer Wheels for Locomotives

Edgewater Steel Company Produces Large Sizes for This Purpose—Method of Manufacture

DURING recent years rolled steel wheels have come into extensive use where steel tired wheels were formerly employed. The latest example of this tendency is found in the application of special rolled steel wheels on the trailing trucks of locomotives. These wheels have been developed by the Edgewater Steel Company of Pittsburgh, Pa., at the suggestion of an eastern railroad.

This extension of the field of rolled steel wheels is due to advantages in first cost and maintenance coupled with the high degree of reliability demanded for the most exacting service. Formerly steel tired wheels were favored for trailer trucks because the tires could be changed readily. On modern locomotives the trailing axles have outside bearings and the wheels must be dropped to change the tires. It is often cheaper to change the wheels and send the parts to the shop for turning than to remove the tires and shrink on a new set. Where this is the case, rolled steel wheels are often preferred.

In developing the roller trailer wheels it was found that the requirements for practically all classes of locomotives could be met by two sizes of wheels, 44 in. and 50 in. diameter with 5½ in. by 3 in. rims. The hubs are 8⅛ in. long and the diameters of the faces, 16 in. and 19 in., the large face being placed inside or outside as desired. The two sizes of wheels mentioned will fit in almost any trailing truck, but other sizes can be made if necessary. One of the illustrations shows four sizes of wheels produced by the Edgewater Steel Company: a 33 in. wheel for freight cars, 44 in. and 50 in. trailer wheels and a 53 in. wheel which was rolled to demonstrate the capacity of the mill.

Although rolled steel wheels are used extensively, few

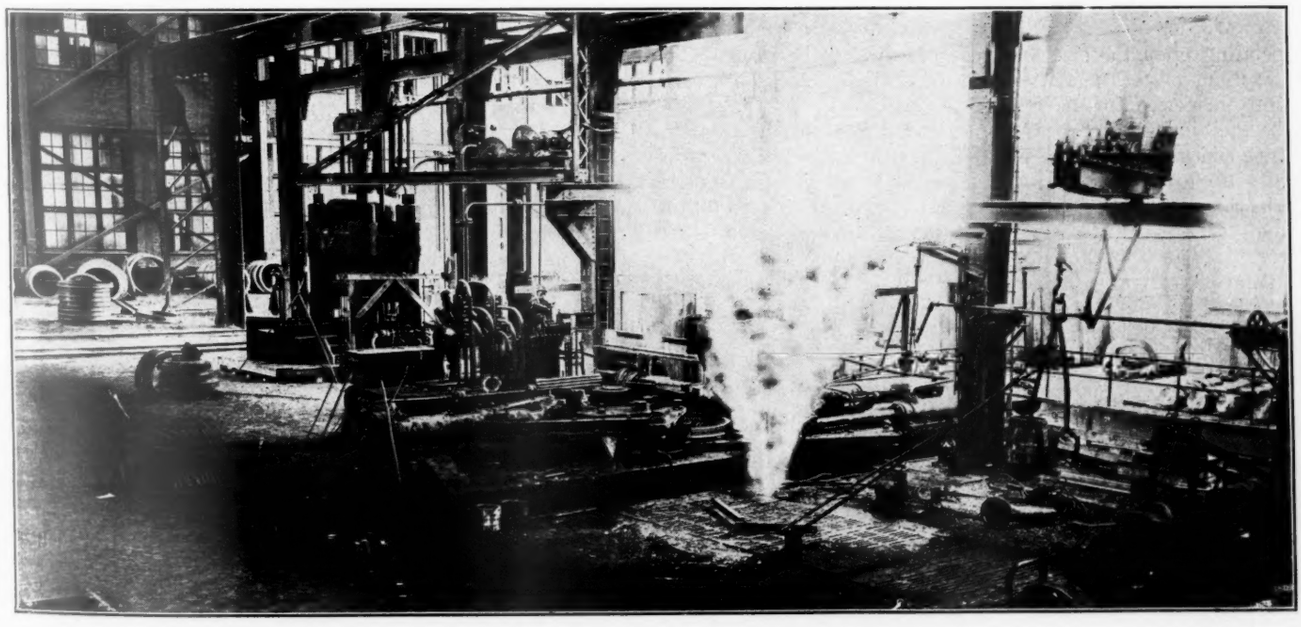


Fig. 1—Special Rolling Mill, Driven by 1,000 Hp. Motor, on Which Wheels and Tires Are Made

railroad men know except in a general way how they are made. The method of manufacture, especially that used by the Edgewater Steel Company, is most interesting.

The first step in producing rolled steel wheels is to make suitable steel. The specifications of the Mechanical Division of the American Railway Association call for the following chemical composition when the steel is made by the basic open-hearth process.

Carbon, 0.65 to 0.85 per cent.
Manganese, 0.55 to 0.80 per cent.
Silicon, 0.10 to 0.30 per cent.
Phosphorus, not over 0.05 per cent.
Sulphur, not over 0.05 per cent.

The Edgewater plant has four open-hearth steel furnaces; two of 75 tons capacity, one of 50 tons capacity, and one of 25 tons capacity. The steel is tapped into ladles and poured into ingot molds which are filled from the bottom in order to reduce the occlusion of gases and insure sound ingots. The composition of the steel is carefully controlled during the making by chemical and physical tests of each heat.

The ingots are allowed to cool and are cut into blocks in slicing lathes, as shown in Fig. 2, the size of the block depending upon the size and type of wheel to be made. The crop end of the ingot is discarded and the blocks are carefully inspected for defects.

The blocks which pass inspection are reheated in a special type continuous furnace which brings the entire block gradually up to a uniform forging heat. From the furnace the block is carried by a semi-automatic conveyor to a 6,000-ton hydraulic press. The first operation on the press is to flatten the block to approximately the width of the wheel rim, this operation serving also to remove the scale. The center is punched out and then the bloom is placed in a set of dies and pressed to the shape of the blank shown in Fig. 2. The blank as it comes from the dies has a hub of the correct dimensions but the diameter over the rim is less than that of the wheel to be made and the rim has no flange.

The finished blank as it comes from the dies is transferred immediately to the rolling mills. One of these mills is illustrated in Fig. 1, the details of the arrangement of the rolls being shown at the right in Fig. 2. By reference to the latter illustration it will be noted that the wheel is held on the rim between seven rolls; the main driven roll shown at the right, two guide rolls, two edging rolls and two pressure rolls mounted between the edging rolls. The actual rolling of the metal is done between the pressure rolls and the edging rolls. These are mounted on a carriage which can be moved toward or away from the main roll at the will of the operator, thus controlling the diameter of the piece being rolled. In this way the diameter of the piece is maintained until the flange and rim are fully formed by the rolls and then increased to the finished size.

The wheel is next transferred to a 2,500-ton hydraulic press where it is dished, giving the hub the required offset from the rim. During this operation the heat number and any other markings required are stamped on the wheel. After the wheels come from the press, they are allowed to cool, after which the hub is bored and faced and the groove showing the limit of wear is cut in the outside of the rim. The wheels are then measured and marked with the tape size, after which they are ready for mounting.

There are two unique features in this method of manufacturing wheels: the piece is developed from the block to the finished wheel in a single heat and the rim is worked on all sides throughout the rolling process. The thorough working of the metal and the low finishing temperature insure the proper structure of the steel in the finished wheel.

The method of making tires for locomotive or car wheels is in many respects similar to the process of making rolled steel wheels and the same machinery is used. The various steps in this process are shown at the left in Fig. 2. In preparing the bloom the center hole is enlarged in order that the bloom may be passed over the pressure roll. The flange is formed in the main roll while the top and bottom edging rolls maintain the proper width of the tire. In rolling tires two mills are used, the roughing mill forming the flange and drawing the tire partly to size, after which the rolling is finished in the second mill. In making tires, as in wheels, all sizes are rolled at one heat, thus insuring all the advantages of a low finishing temperature.

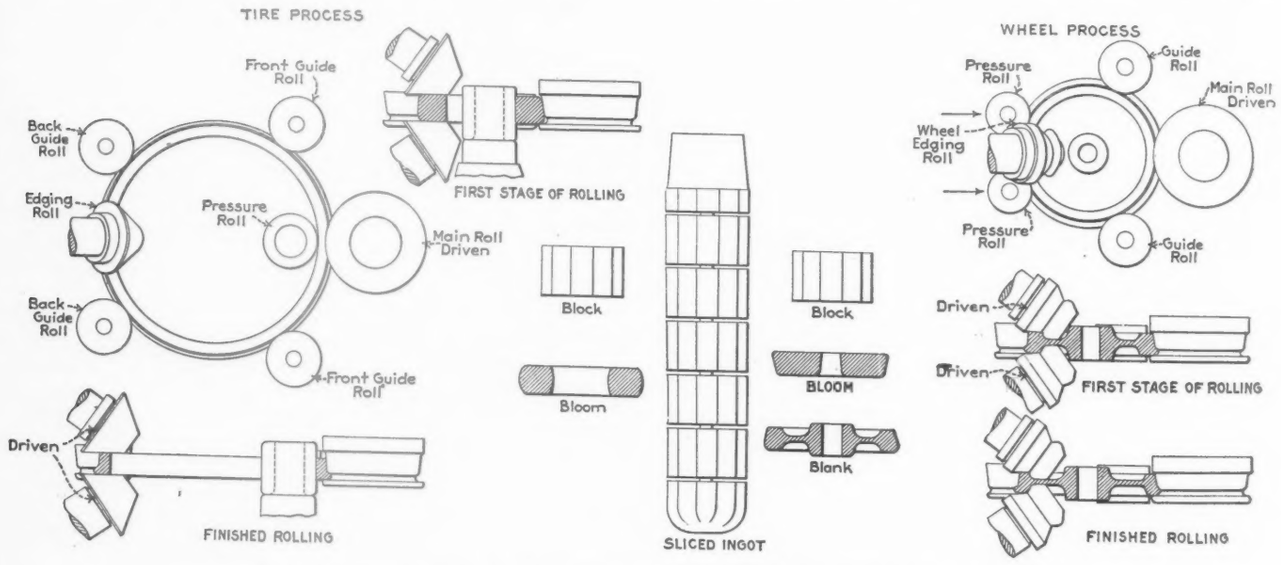


Fig. 2—Successive Steps in Converting an Ingot Into Rolled Steel Wheels or Tires

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VALUABLE RECORDS of the Nashville, Chattanooga & St. Louis were destroyed in a fire which burned a building of that company in Nashville, Tenn., on March 3; estimated total loss $50,000.

FIFTY PER CENT is the reduction reported by the Philadelphia & Reading in the number of fatal accidents to employees in 1921, as compared with 1920; sixty-eight killed in the last year and 34 in the year before. There was also a material reduction in the number injured.

Treated Water Improves Locomotive Performance

Six Years' Use of Soda Ash Demonstrates Value in Avoiding Failures, Reducing Repairs and Saving Fuel

By W. A. Pownall
Mechanical Engineer, Wabash Railway

THE writer has always taken great interest in the matter of scale prevention in boilers because of the large financial returns possible and would like to present for the information of those interested the results of systematic methods of boiler water treatment as in effect on the Wabash for the past 10 years.

Tests of Soda Ash Treatment

During the period 1902 to 1906, extensive service tests of soda ash treatment and observations of results were made on one of the large railroads. These tests showed conclusively that the treatment of all waters with enough soda ash to neutralize the sulphate hardness and provide enough excess always to show an excess of sodium carbonate in water drawn from the boiler, in connection with the systematic blowing off of the boiler through a blowoff cock properly located would accomplish the following principal results:

(1) Keep heating surfaces comparatively free from scale. (2) Cause the scale forming solids, instead of crystallizing on the heating surface, to be deposited as a soft sludge and be carried back to the point of least circulation, the back mud ring, where it could be removed through means of a perforated pipe connected to the blow-off cock in the back corner. (3) Practically eliminate engine failures due to leaking flues, fire boxes, stay bolts, mud rings, etc. (4) Reduce stay bolt breakage and fire box renewals to a very low figure. (5) Decrease the cost of boiler repairs from 30 to 65 percent. (6) Increase mileage between boiler washings to any desired amount. The tests also established the fact that the boiler would foam when the total dissolved solids were about 240 parts per 100,000 and that enough blowing off must be done always to keep below that point.

With full knowledge that these results were being obtained and that all methods were based not on any theorizing as to effects, but on actual observations of results, the Wabash started this method of treating water in roadside supply tanks with soda ash only and at every station where water contained any sulphates of lime and magnesia. Waters containing natural sodium carbonate, even though having a hardness of 20 to 40 parts per 100,000 are used in stationary boilers at several of our plants and do not form scale, the boilers being free from scale after having been in service for many years. Observations of boilers using this type of water ought to be evidence enough to any thoughtful investigator that similar results can be obtained on other waters containing sulphate hardness if enough soda ash is added to neutralize this hardness, or in other words to make it like the natural non-scaling water.

Let me emphasize, before discussing results, the fact that this method demands that all sulphate hardness waters over an operating district must be treated in order to obtain results. Treatment here and there by soda ash only will give practically no good results, and it is probable that experience with this sort of partial treatment has condemned this method in many cases.

Water treatment was started on the Wabash in 1912, and gradually extended until complete in 1916, when the total number of waters treated was 109. On one division this company operates over another road, and has not therefore been in a position to treat the water at roadside tanks. However, treatment has just been started on this division by placing enough soda ash in the tank at the terminal to treat all water used over the division, and although this is a crude method and one needing careful supervision, the results at the present writing are encouraging.

Engine Failures Due to Leaky Flues, Staybolts, Fireboxes, Etc.

A failure due to boiler leaking is an expensive failure since it usually involves giving up the train and having another engine and crew come out after the train and failed engine. Aside from the expense, leaking boiler failures are an absolute indication, particularly in cold weather, as to whether or not heating surfaces have scale on them, and are also evidence of all the other incidental troubles that go with scale. The following table shows the improvement in reducing failures due to leaking for the year 1921, as compared with the year 1911, the year before treatment was started.

ENGINE FAILURES DUE TO LEAKING FLUES, FIREBOXES, ETC.

Division	No. of failures 1911	No. of failures 1921	Per cent Decrease	Miles per failure 1911	Miles per failure 1921
Detroit	141	0	100.0	21,653	No failures
Peru	236	2	99.1	12,811	1,160,425
Decatur	232	4	98.3	20,878	989,068
Springfield	57	0	100.0	33,303	No failures
Moberly	265	23	91.3	25,596	248,035
Total	931	29	96.9	20,770	541,748

It will be noted that on two divisions the failures were entirely eliminated, on two other divisions they were practically eliminated and for all divisions the percentage of decrease was 96.9. The mileage per failure increased from 20,700 in 1911 to 541,748 in 1921. This improvement has not been made through the welding of flues into sheets, as this has been done on only a few engines and only on the superheater flues on divisions where the erratic water conditions and necessity for occasional use of very bad water made it seem advisable to weld in some of the superheater flues after they have been in service a year or two.

A good example of what has been accomplished is shown by the performance of 25 2-10-2 engines placed in service in July, 1917, on what was before treatment considered the hardest water division. These engines have flues 23 ft. long. During the 4½ years of service there have been seven failures due to leaking flues. The average time to first resetting of flues was 39 months, thirteen of the engines making from 40 to 48 months actual service. The average flue mileage on the ten highest engines (and one has not yet had the flues reset) is 116,477. Each engine has 3,047 staybolts including 2,320 rigid stays, 639 American flexible stays and 88 Tate flexible staybolts. There have been only 14 staybolts broken on the entire 25 engines. There are passenger engines running on this same division with nearly 300,000 miles between flue resetting.

Fire Box and Staybolt Renewals

Up to 1915 the firebox work on the Wabash was rather heavy, and the road did not begin to really feel the effect of water treatment in decreased firebox renewals until after 1915. However, from that time on there was a steady decrease in the number of new fireboxes applied each year, the records for the last three years showing a reduction in firebox renewals of 93 per cent over 1915. At the same time there have not been many renewals of side sheets or part side

sheets. It is to be expected that there will be certain cycles of firebox life and that there may be in the future a few years with heavier firebox renewal, but generally speaking the indications are that obsolescence will overtake renewal.

The records of staybolt renewals per locomotive per year show that on the best treated division about one bolt per locomotive per year is renewed, whereas on the one division that has not had treated water, and which is not a really bad water division, the broken bolts per locomotive per year are 52. The broken bolts on the heaviest power on the Wabash consisting of Pacific, Consolidation, Mikado and Santa Fe type locomotives, all of which operate under treated water conditions, was from June, 1920, to July, 1921, only 0.77 bolts per locomotive per year. These locomotives are equipped with flexible staybolts in the breaking zones only.

Fuel Performance

Keeping heating surface free from scale results in considerable fuel saving. As a rough method of showing the fuel saving the total tons of coal used in locomotive service each year have been divided by total equivalent ton miles, obtained by assigning an increased ton mile value to passenger car ton miles and assuming that switch engine ton miles is a function of freight ton miles. The omission of a separate figure for switching service ton miles explains what may appear to be a high value for "lb. of coal per ton mile." This figure was kept up to 1919 and shows the following:

Year ending June 30.	1912	1913	1914	1915	1916	1919 (Dec. 31)
Lb. coal equivalent per 100 ton miles	32.7	31.65	30.93	29.2	27.0	25.75
Per cent decrease over 1912	0	3.21	5.41	10.69	17.41	21.25

The decrease in fuel consumption from the year previous to water treatment to 1919 was 21.25 per cent, part of which can be attributed to extended use of superheater engines and brick arch, and the formation of a competent fuel organization.

Cost of Water Treatment

Considerable has been said in articles in the *Railway Age* about the heavy cost of blowing out. The officers of the Wabash realize that considering the waste of fuel and water, the cost of blowing off is possibly the major part of the cost of water treatment, but there is no guess work as to this expense. On an ordinary division where the treatment will average 0.6 lb. of soda ash per 1,000 gallons of water, after the engine has made several hundred miles since the boiler was washed, it will then be necessary to blow out about 4 per cent of the water to keep below the foaming point. This will entail a fuel waste of approximately 1.1 per cent of the coal used, and the total cost of the coal and water wasted would be about $0.026 per 1,000 gallons. The average cost between washouts will be less than this, since very little blowing is done after washout until the concentration has reached the foaming point. This cost should always be considered as a part of the cost of water treatment. Under ordinary conditions it is usually cheaper to blow out a boiler than to wash it out at the terminal, but this cost of blowing out should never deter one from treating water, as it is much more than offset by fuel saving from clean heating surfaces and by other attendant benefits.

One thing that is very essential to the successful use of treated water is the support of the enginemen. It is their intelligent use of the blow-off cock that makes it possible to use this method of treatment. Blowing off a glass of water when the engine reaches its terminal relieves the engineman of part of the burden, but in freight service it is still necessary for considerable blowing off to be done between terminals.

I have read carefully the various articles brought about by Mr. Knowles' paper, and I do not feel like criticising any of the statements made but simply wish to present results that speak for themselves, and which will always be open to investigation by anybody interested. As regards the use of boiler compound, I agree with Mr. Bardwell—there is no mystery. It is a clean-cut proposition in which one knows what is used for treatment, and knowing what is in the water, and the amount of treatment applied, should know what to expect in the way of results. The use of anti-foaming compound reduces the amount of blowing off necessary, and where the alkali salts in the treated water are not very high and it is not desired to make large mileage between washouts or water changes, the use of the anti-foaming compound should make it possible to get along without blowing off. On districts where the natural alkali salts are high, the anti-foaming compound has been found a necessity for practical operation.

The statement made by Mr. Coyle of the Great Northern, that a foaming point of 200 grains per gallon had been settled on because it happened to be the foaming point in a boiler where a lot of sludge and fine scale was set loose, does not agree with our experience. We have found through analyses of many thousands of waters taken from locomotive boilers which have been free from scale for years, that the water will foam when the concentration of dissolved solids is about 240 parts per 100,000. This varies somewhat; it will be a little lower if there is any unusual amount of mud in the water or decayed vegetable matter, and will run a little higher when all waters are clear.

Wabash boiler waters are in general not high in sulphate hardness, although rather high in total hardness, so that when untreated they form heavy scale. We appreciate that waters on railroads further west and in the Southwest are in many cases very high in sulphates as well as in foaming solids, and that treatment presents a much more serious and difficult problem than we have had to deal with.

Any steam user who does not use some method of treatment to prevent scale formation in his boilers is over-looking an opportunity to save much money. Whether scale prevention is to be accomplished by the use of boiler compound, by soda ash, or by water softeners is governed by financial conditions—any method pays; but any one of these methods in order to be successful must be accompanied by proper and intelligent supervision. The greatest argument against the treatment with soda ash alone is the foaming tendency of the treated water or the cost of blowing off to overcome this foaming tendency. If all waters were treated through the softener the low amount of lime solids in the treated water would make it possible to run with higher concentration before foaming took place, and consequently with a lower cost for blowing off. Information as to how high concentration can be carried in the boiler water before foaming takes place when all waters are treated through softeners could possibly be furnished by a few roads that have a complete division or divisions equipped with softeners. This figure may be rather high where anti-foaming compound is used in connection with the completely softened water. On the other hand, there is the possibility of some one, or several plants not operating properly at all times which would mean an increase in lime solids with resultant foaming concentration not much greater than with other methods of treatment.

The saving due to reducing blowing off can be figured at a definite value per 1,000 gallons of water and set against the interest, depreciation and operating charges for the softeners. Similarly, costs can be figured in determining whether the use of anti-foaming compound to reduce the amount of blowing off would be profitable. Some value should be attached to the psychological effect on enginemen of not having to do so much blowing off.

Nothing in the foregoing should be construed as in opposition to any method of treatment. Each method, if properly supervised, may accomplish from partial to complete results in scale prevention, and I have merely tried to show results which have been obtained on the Wabash through the use of soda ash, and are possible on any other railroad.

Calculating the Efficiency of Boiler Seams

Tables Reduce the Chance for Error and Facilitate Work; Points Where Failure Is Likely to Occur

By R. J. Finch
American Locomotive Company, Schenectady, N. Y.

TO determine the efficiency of a seam, it is necessary to calculate the breaking strength by the different ways in which it may fail; namely, by shearing the rivets, tearing the plates between rivets, crushing the rivets or plate, or by a combination of two or more of the foregoing causes. The calculation which shows the least result is the actual strength of the seam. Thus, the efficiency of a seam is the ratio of the actual strength of the seam, or the strength of its weakest part, to the strength of the solid plate.

To make these calculations is a tedious task, especially if the calculations are made longhand and no slide rules or calculating machines are available. The purpose of this article is to present two tables with an explanation of their use. These tables when thoroughly understood and then made use of, will shorten the work of finding the efficiency by at least one-half. The short method eliminates the tedious work and consequently, in making the calculations one is not so apt to overlook some vital point of weakness in the seam, which point may be out of the ordinary but still may exist. It is also the purpose of this article to indicate the places where weakness, or the point of lowest efficiency, may occur and yet might be easily overlooked.

To explain the use of the tables, two sketches of parts of longitudinal seams are shown. Fig. 1 shows a section of a

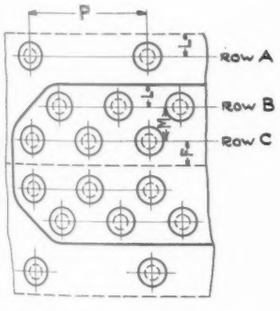


Fig. 1—Sextuple Riveted Seam

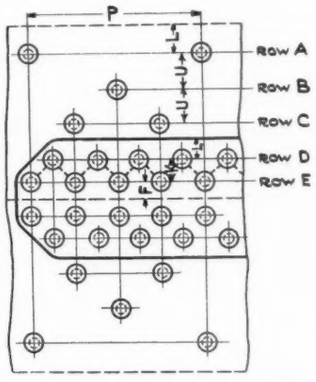


Fig. 2—Decuple Riveted Seam

sextuple riveted seam and Fig. 2 a section of a decuple riveted seam. While only the two types of seams are here shown, it should be understood that the tables apply equally well to a quadruple, octuple or any other type of riveted seam.

Table I shows the "value of rivet holes in plates," or possibly it might be more explicit to say that this table shows the strength removed from the plate for various sizes of holes and thicknesses of plate. The table is based on an ultimate tensile strength of 55,000 lb. per square inch for boiler steel, which figure is almost universally used. The table ranges in thickness of plates from ¼ in. to 1 5/16 in., and in rivet diameters from ½ in. to 1 7/16 in., or a range in rivet hole diameters from 9/16 in. to 1½ in., the diameter of the driven rivet being taken as 1/16 in. larger than the rivet before driving.

Table II gives the shearing value of iron and steel rivets for the different sizes of rivets shown in Table I. This table is based on an ultimate shearing strength of iron rivets of 38,000 lb. per sq. in., and 40,000 and 44,000 lb. per sq. in. for steel rivets, the shearing strengths of 38,000 and 44,000 being those allowed by the Interstate Commerce Commission, while 40,000 lb. for steel rivets is the American Locomotive Company's practice.

Calculating the Efficiency of Seams

Referring to sextuple seam (Fig. 1) and assuming the pitch, *P*, is 8 in., diameter of rivet before driving 1⅛ in., after driving 1 3/16 in., thickness of plate 13/16 in., steel rivets being used, the efficiency through outer row, *A*, is found to be as follows:

$$\frac{8 - 1\ 3/16}{8} = 85.1 \text{ per cent}$$

To find the efficiency through other rows of rivets, proceed as follows:

Strength of solid plate is—

$$8 \times 13/16 \times 55{,}000 = 357{,}500 \text{ lb.}$$

In row *B* two rivet holes have been taken out, but if the plate fails here, it must shear off one rivet (two halves) in the outer row.

From Table I it is found that the strength removed is 2 × 53,066 lb. and the strength added, from Table II, is 48,730 lb. The efficiency through row *B* then is

$$\frac{357{,}500 - (2 \times 53{,}066) + 48{,}730}{357{,}500} = 83.9 \text{ per cent}$$

In row *C* two rivet holes are taken out, but to fail here it would be necessary to shear off five rivets (two rivets in double shear and one in single shear) and it is readily seen that the added strength is considerably more than the removed strength and no calculations are necessary.

The efficiency has been found by breaking through the different rows and the next step is to find the efficiency due to shearing of the rivets as a whole. To fail in this manner it is necessary to shear off nine rivets (four in double shear and one in single shear).

Then,

$$\frac{48{,}730 \times 9}{357{,}500} = 122.7 \text{ per cent, efficiency of rivets}$$

The efficiency of this seam is the value found for row *B*, or 83.9 per cent.

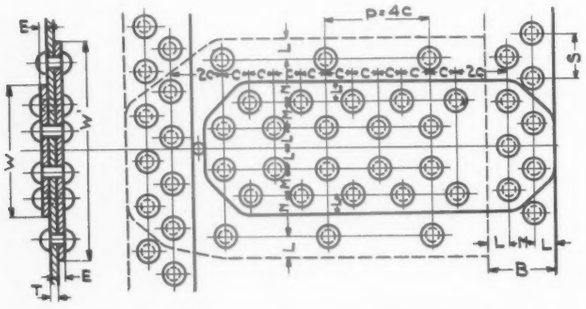
If the thickness of the plate had been assumed 11/16 in. instead of ¾ in., the strength of the metal removed by one rivet hole would be 44,902 lb. instead of 53,066 lb. It is at once noted that the least efficiency is in the outside row and is 85.1 per cent; in other words, on a seam of this type, when the shear of a rivet is greater than the strength removed by a rivet hole, the least efficiency must be in the outer row of rivets and it is not necessary to make any calculations for the efficiency of other rows. The shear of the rivets as a whole should always be calculated, as it sometimes happens, although seldom, that the least efficiency may be in the rivets.

Decuple Riveted Seam

The decuple riveted seam, Fig. 2, is taken care of identically the same as the sextuple riveted seam, except that

an inspection of values from the two tables will quickly show that the efficiency through rows *B*, *C* and *E* must always be greater than the efficiency through the outer row, and, therefore, these rows in a riveted seam of this type need not be considered. The efficiency of the outer row is found exactly the same as for the sextuple riveted seam and the efficiency through row *D* is found the same as for row *B* of the sextuple seam, except that the tensile value of four rivet holes is deducted and the shearing strength of four rivets added. If the shearing value of a rivet is more than the strength removed by a rivet hole, it is useless to do any figuring for this row as it is at once noted that the efficiency will be more than in the outer row. The efficiency for the shear of the rivets as a whole is also found by the same method as for the sextuple riveted seam, except here the shear of 20 rivets (8 in double shear and 4 in single shear) is compared with the strength of the solid plate.

As for further points to be considered in calculating seam efficiencies, attention is called to the distance from the row of rivets to the edge of the welts (both inner and outer) or the dimension *L* on Figs. 1 and 2. In a well designed seam this distance or dimension *L* should always be great enough to insure that the metal between the rivet and the edge of

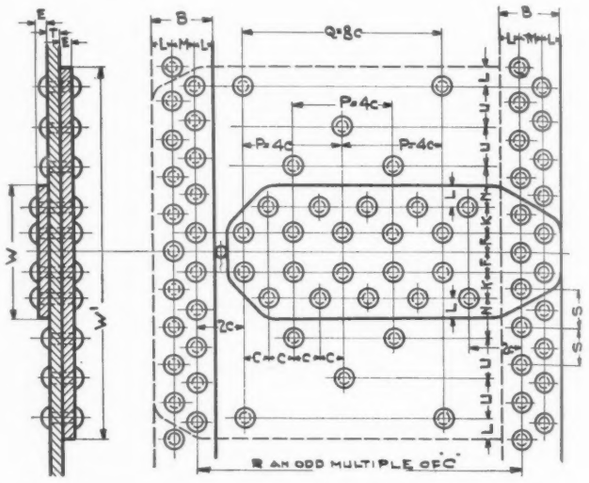


LONGITUDINAL SEAMS												CIRCUMFERENTIAL SEAMS				
T	DIA. OF RIVETS	DIA. OF HOLES	C	P	L	M	N	E	W	W'	PERCENT EFF.	S	L	M	B	PERCENT EFF.
3/32	3/16	13/64	1/4	5	1 1/8	1 1/2	2 3/8	3/8	7 1/2	12 3/4	83.7	2 3/8	1 1/8	1 1/2	3 3/8	70.5
7/64	3/16	13/64	1 1/2	6	1 1/8	1 5/8	2 3/8	3/8	9	14 1/2	84.3	3	1 1/4	1 3/8	4 1/2	68.7
1/8	3/16	13/64	1 1/2	6	1 1/8	1 3/4	2 3/8	7/16	9	14 1/2	84.3	3	1 1/4	1 3/4	4 1/4	68.7
9/64	3/16	13/64	1 1/2	6	1 1/8	1 3/4	2 3/8	7/16	9	14 1/2	84.3	3	1 1/4	1 3/4	4 1/4	68.7
5/32	3/16	13/64	1 1/2	6	1 1/8	1 3/4	2 3/8	7/16	9	14 1/2	84.3	3	1 1/4	1 3/4	4 1/4	66.9
11/64	1	1 1/16	1 3/4	7	1 1/2	1 7/8	3	7/16	9 3/4	15 3/4	84.8	3 1/4	1 1/2	1 3/4	4 3/4	67.4
3/16	1	1 1/16	1 3/4	7	1 1/2	1 7/8	3	1/2	9 3/4	15 3/4	84.8	3 1/4	1 1/2	1 3/4	4 3/4	67.4
13/64	1	1 1/16	1 3/4	7	1 1/2	1 7/8	3	1/2	9 3/4	15 3/4	84.8	3 1/4	1 1/2	1 3/4	4 3/4	66.8
7/32	1	1 1/16	1 3/4	7	1 1/2	1 7/8	3	9/16	9 3/4	15 3/4	84.4	3 1/4	1 1/2	1 3/4	4 3/4	63.5
15/64	1 1/8	1 3/16	2	8	1 5/8	2 1/8	3 1/4	9/16	10 3/4	17 1/4	85.1	3 1/2	1 5/8	2	5 1/4	66.0
1/4	1 1/8	1 3/16	2	8	1 5/8	2 1/8	3 1/4	9/16	10 3/4	17 1/4	84.9	3 1/2	1 5/8	2	5 1/4	66.0
17/64	1 1/8	1 3/16	2	8	1 5/8	2 1/8	3 1/4	9/16	10 3/4	17 1/4	84.3	3 1/2	1 5/8	2	5 1/4	63.9
9/32	1 1/8	1 3/16	2	8	1 5/8	2 1/8	3 1/4	9/16	10 3/4	17 1/4	83.6	3 1/2	1 5/8	2	5 1/4	61.4
19/64	1 1/8	1 3/16	2	8	1 5/8	2 1/8	3 1/4	9/16	10 3/4	17 1/4	83.1	3 1/2	1 5/8	2	5 1/4	58.9
5/16	1 1/8	1 3/16	2	8	1 5/8	2 1/8	3 1/4	9/16	10 3/4	17 1/4	82.6	3 1/2	1 5/8	2	5 1/4	56.6
21/64	1 1/4	1 5/16	2 1/4	9	1 3/8	2 3/8	3 1/2	11/16	11 1/4	18 1/4	83.8	3 3/8	1 3/8	2 1/4	5 3/8	62.2
11/32	1 1/4	1 5/16	2 1/4	9	1 3/4	2 3/8	3 1/2	11/16	11 1/4	18 1/4	83.3	3 3/8	1 3/4	2 1/4	5 3/8	60.0
23/64	1 1/4	1 5/16	2 1/4	9	1 3/4	2 3/8	3 1/2	11/16	11 1/4	18 1/4	82.9	3 3/8	1 3/4	2 1/4	5 3/8	57.9
3/8	1 1/4	1 5/16	2 1/4	9	1 3/4	2 3/8	3 1/2	11/16	11 1/4	18 1/4	82.5	3 3/8	1 3/4	2 1/4	5 3/8	56.0
25/64	1 1/4	1 5/16	2 1/4	9	1 3/4	2 3/8	3 1/2	11/16	11 1/4	18 1/4	82.2	3 3/8	1 3/4	2 1/4	5 3/8	54.1
1	1 1/4	1 5/16	2 1/4	9	1 3/4	2 3/8	3 1/2	11/16	11 1/4	18 1/4	81.7	3 3/8	1 3/4	2 1/4	5 3/8	52.5

Fig. 3—American Locomotive Company's Standard Sextuple Seam

the welt will stand the full shear of the rivet. This should always be calculated, and if found to be less than the value of the rivet, this value must be substituted instead of the rivet value for these particular rivets. Likewise, the dimension *F* (distance from inner row to center line of the seam) shown on Figs. 1 and 2 must be sufficient so that the metal between the rivet and the edge of the plate will stand the double shear of the rivet. If it should be found less than the rivet, this value must also be substituted. To compare this shearing strength of the plate behind the rivet with the strength of the rivet itself, it is simply necessary to find the cross sectional area of the metal behind the rivet in square inches and multiply this area by 100,000 lb. The crushing or shearing value of the plate is 50,000 lb. per sq. in., and this metal being in double shear accounts for the figure given above.

Another point to be considered for possible weakness is the back pitch, or distance between the longitudinal rows of rivets, dimension *M* in Fig. 1, sextuple seam, and dimen-



LONGITUDINAL SEAM														CIRCUMFERENTIAL SEAM				
T	DIA. OF RIVETS	DIA. OF HOLES	C	P	Q	F	K	N	U	E	F'	W	W'	L	PERCENT EFFICIENCY	S	L	M	B	PERCENT EFFICIENCY
21/32	1 1/4	1 5/16	2	8	16	1 5/8	2 1/8	3 3/4	3 3/4	9/16	1/2	10 3/4	33 1/4	1 5/8	92.6	3 1/2	1 5/8	2	5 1/4	66.6
11/16	1 1/8	1 5/16	2	8	16	1 5/8	2 1/8	3 3/4	3 3/4	9/16	1/2	10 3/4	33 1/4	1 5/8	92.6	3 1/2	1 5/8	2	5 1/4	66.0
23/32	1 1/8	1 5/16	2	8	16	1 5/8	2 1/8	3 3/4	3 3/4	9/16	1/2	10 3/4	33 1/4	1 5/8	92.6	3 1/2	1 5/8	2	5 1/4	63.9
3/4	1 1/8	1 5/16	2	8	16	1 5/8	2 1/8	3 3/4	3 3/4	9/16	1/2	10 3/4	33 1/4	1 5/8	92.6	3 1/2	1 5/8	2	5 1/4	61.4
25/32	1 1/8	1 5/16	2	8	16	1 5/8	2 1/8	3 3/4	3 3/4	9/16	1/2	10 3/4	33 1/4	1 5/8	92.6	3 1/2	1 5/8	2	5 1/4	58.9
13/16	1 1/8	1 5/16	2	8	16	1 5/8	2 1/8	3 3/4	3 3/4	9/16	1/2	10 3/4	33 1/4	1 5/8	92.6	3 1/2	1 5/8	2	5 1/4	56.6
27/32	1 1/4	1 5/16	2 1/4	9	18	1 3/4	2 3/8	4	4	11/16	5/8	11 3/4	35 3/4	1 3/4	92.7	3 3/4	1 3/4	2 1/4	5 3/8	62.2
7/8	1 1/4	1 5/16	2 1/4	9	18	1 3/4	2 3/8	4	4	11/16	5/8	11 3/4	35 3/4	1 3/4	92.7	3 3/4	1 3/4	2 1/4	5 3/8	60.0
29/32	1 1/4	1 5/16	2 1/4	9	18	1 3/4	2 3/8	4	4	3/4	11/16	11 3/4	35 3/4	1 3/4	92.7	3 3/4	1 3/4	2 1/4	5 3/8	57.9
15/16	1 1/4	1 5/16	2 1/4	9	18	1 3/4	2 3/8	4	4	3/4	11/16	11 3/4	35 3/4	1 3/4	92.7	3 3/4	1 3/4	2 1/4	5 3/8	56.0
31/32	1 1/4	1 5/16	2 1/4	9	18	1 3/4	2 3/8	4	4	3/4	11/16	11 3/4	35 3/4	1 3/4	92.7	3 3/4	1 3/4	2 1/4	5 3/8	54.1
1	1 5/16	1 3/8	2 1/2	10	20	2	2 1/2	4	4 1/2	3/4	11/16	12 1/4	37 1/4	1 7/8	93.1	3 3/4	1 7/8	2 3/8	6 1/8	57.6
1 1/32	1 5/16	1 3/8	2 1/2	10	20	2	2 1/2	4	4 1/2	13/16	3/4	12 1/4	37 1/4	1 7/8	93.1	3 3/4	1 7/8	2 3/8	6 1/8	55.9
1 1/16	1 5/16	1 3/8	2 1/2	10	20	2	2 1/2	4	4 1/2	13/16	3/4	12 1/4	37 1/4	1 7/8	92.8	3 3/4	1 7/8	2 3/8	6 1/8	54.3
1 1/32	1 5/16	1 3/8	2 1/2	10	20	2	2 1/2	4	4 1/4	7/8	13/16	12 1/4	37 1/4	1 7/8	92.2	3 3/4	1 7/8	2 3/8	6 1/8	52.8
1 1/8	1 5/16	1 3/8	2 1/2	10	20	2	2 1/2	4	4 1/2	7/8	13/16	12 1/4	37 1/4	1 7/8	91.7	3 3/4	1 7/8	2 3/8	6 1/8	51.2

Fig. 4—American Locomotive Company's Standard Decuple Seam

sions *U* and *K* in Fig. 2, decuple seam. Here it is essential that this distance be sufficiently great, so that the diagonal distance with two rows of rivet holes deducted, be greater than the straight distance with one row of rivet holes deducted. In other words, the net breaking strength through the diagonal must be greater than the net breaking strength through the straight rows, or the sheet might break sawtooth fashion and the calculations for efficiency be upset. (A dotted line in Fig. 2 shows what is meant by breaking diagonally between rows.) In order to be assured of the proper distance for the back pitch, it is advisable, when designing seams, to have some sort of a formula that will give the desired distance. This condition is well covered by the formulæ given in the A.S.M.E. Rules for the Construction of Boilers of Locomotives, Part I, Section III, of the A.S.M.E. Boiler Code, page 8, paragraph L-23.

Seams of high efficiency, like the decuple seam illustrated in Fig. 2 and the diamond seam, which will be discussed

later, are used where a saving of weight is important, and oftentimes the welts (both inner and outer) are made thin to save weight, but there is a limit to the reduction in thickness of the welt strips. Suppose for example, this decuple seam was used on a plate 1⅛ in. thick and this seam was to have an efficiency of 92 per cent. Should the welts be made only 9/16 in. thick, both welts could then fail through row *E*, leaving this row of rivets intact in the plate itself. Therefore, it is very important that the ratio of net area of the metal in the two welts through the row of rivets next to

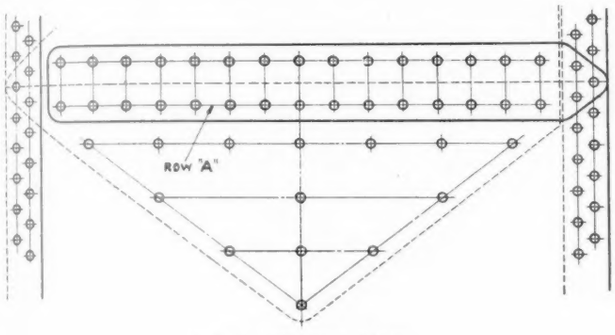


Fig. 5—Diamond Seam

the center line of the seam to the plate be at least equal to the percentage of efficiency of the seam.

The American Locomotive Company's standard sextuple riveted seams are shown in Fig. 3, while Fig. 4 shows standard decuple seams. These tables not only show rivet pitches, rivet diameters, thicknesses and widths of welts for the different thicknesses of plates, but also carry the efficiencies for different plate thicknesses. The efficiencies shown on these standard seams are on the basis of an ultimate tensile strength of plates of 55,000 lb. per sq. in. and 40,000 lb. per sq. in. for shear of rivets. In checking the efficiencies of these seams by the method given above, the line next the bottom in Table II should be used for rivet values, or the line based on a rivet shear of 40,000 lb. per sq. in.

The question might be asked as to the reason for having both a standard sextuple and decuple riveted seam covering the same thickness of plates. The American Locomotive Company's general practice is to use the sextuple riveted seam on smaller boilers, up to approximately 65 in. diameter, and the decuple seam for larger sizes. The decuple seam has an efficiency about eight per cent greater than the sextuple seam, and by using this seam the same factor of safety is obtained with correspondingly thinner plates. In cases where a saving in weight is important, the decuple riveted seam is often used where the diameter is less than 65 in., and vice versa, larger boilers than 65 in. are built with sextuple riveted seams due to some modifying factor, such as railroad company's specification, additional weight required, etc.

It is within the limits of possibility to design a seam with a higher efficiency than the decuple seam shown, the most common type being the diamond seam illustrated by Fig. 5. This seam on long barrel courses and properly designed, can have a theoretical efficiency as high as 98 per cent. There are, however, certain drawbacks to a seam of too high an

TABLE I—REDUCTION IN TENSILE STRENGTH OF PLATES DUE TO RIVET HOLES OF VARIOUS SIZES

BASED ON PLATES HAVING A TENSILE STRENGTH OF 55,000 LB. PER SQ. IN.

Diameter of rivet, inches / Diam. of rivet hole, inches / Thickness of plate, inches	½ / 9/16	9/16 / 5/8	5/8 / 11/16	11/16 / 3/4	3/4 / 13/16	13/16 / 7/8	7/8 / 15/16	15/16 / 1	1 / 1 1/16	1 1/16 / 1 1/8	1 1/8 / 1 3/16	1 3/16 / 1 1/4	1 1/4 / 1 5/16	1 5/16 / 1 3/8	1 3/8 / 1 7/16	1 7/16 / 1 1/2
1/4	7,734	8,594	9,453	10,313	11,172	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
5/16	8,701	9,668	10,635	11,602	12,568	13,535	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3/8	9,668	10,742	11,816	12,891	13,965	15,039	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
7/16	10,635	11,816	12,998	14,180	15,361	16,543	17,725	.....	.....	.....	.....	.....	.....	.....	.....	.....
3/8	11,602	12,891	14,180	15,469	16,758	18,047	19,336	.....	.....	.....	.....	.....	.....	.....	.....	.....
7/16	12,568	13,965	15,361	16,758	18,154	19,551	20,947	22,344	.....	.....	.....	.....	.....	.....	.....	.....
1/2	13,535	15,039	16,543	18,047	19,551	21,055	22,559	24,063	25,566	.....	.....	.....	.....	.....	.....	.....
9/16	.....	16,113	17,725	19,336	20,947	22,559	24,170	25,781	27,393	29,004	.....	.....	.....	.....	.....	.....
1/2	.....	.....	18,906	20,625	22,344	24,063	25,781	27,500	29,219	30,938	.....	.....	.....	.....	.....	.....
9/16	.....	.....	.....	21,914	23,740	25,567	27,393	29,219	31,045	32,871	34,697	.....	.....	.....	.....	.....
5/8	.....	.....	.....	.....	25,137	27,071	29,004	30,937	32,871	34,305	36,738	.....	.....	.....	.....	.....
11/16	.....	.....	.....	.....	26,533	28,575	30,615	32,656	34,697	36,738	38,779	.....	.....	.....	.....	.....
5/8	.....	.....	.....	.....	.....	30,078	32,226	34,375	36,523	38,672	40,820	42,969	.....	.....	.....	.....
11/16	.....	.....	.....	.....	.....	31,582	33,837	36,094	38,350	40,605	42,861	45,117	.....	.....	.....	.....
3/4	.....	.....	.....	.....	.....	.....	35,449	37,813	40,176	42,539	44,902	47,266	49,629	.....	.....	.....
13/16	.....	.....	.....	.....	.....	.....	.....	39,531	42,002	44,473	46,943	49,414	51,885	.....	.....	.....
3/4	.....	.....	.....	.....	.....	.....	.....	41,250	43,828	46,406	48,984	51,563	54,141	.....	.....	.....
13/16	.....	.....	.....	.....	.....	.....	.....	.....	45,654	48,340	51,025	53,711	56,396	59,082	.....	.....
7/8	.....	.....	.....	.....	.....	.....	.....	.....	47,486	50,273	53,066	55,859	58,652	61,445	.....	.....
15/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	52,207	55,107	58,008	60,908	63,809	.....	.....
7/8	.....	.....	.....	.....	.....	.....	.....	.....	.....	54,141	57,148	60,156	63,164	66,172	.....	.....
15/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	59,189	62,305	65,420	68,535	71,650	.....
1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	61,230	64,453	67,676	70,898	74,121	.....
1 1/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	63,271	66,602	69,932	73,262	76,592	.....
1 1/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	65,313	68,750	72,188	75,625	79,063	82,500
1 1/8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	70,898	74,443	77,988	81,533	85,078
1 3/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	73,047	76,699	80,352	84,004	87,656
1 1/4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	75,195	78,955	82,715	86,475	90,234
1 1/8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	77,344	81,211	85,078	88,945	92,812
1 3/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	83,467	87,441	91,416	95,391
1 1/4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	85,723	89,805	93,887	97,969
1 5/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	87,979	92,168	96,357	100,547
1 1/4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	90,234	94,531	98,828	103,125
1 5/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	92,490	96,895	101,299	105,703
1 3/8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	94,746	99,258	103,770	108,281

TABLE II—SHEARING VALUE OF IRON AND STEEL RIVETS

Diameter of rivet, inches.	½	9/16	5/8	11/16	¾	13/16	7/8	15/16	1	1 1/16	1 1/8	1 3/16	1 1/4	1 5/16	1 3/8	1 7/16
Area of rivet, sq. in.	.1963	.2485	.3068	.3712	.4418	.5185	.6013	.6903	.7854	.8866	.9940	1.1075	1.2272	1.3530	1.4849	1.6230
Diameter of rivet hole, Inches	9/16	5/8	11/16	¾	13/16	7/8	15/16	1	1 1/16	1 1/8	1 3/16	1 1/4	1 5/16	1 3/8	1 7/16	1 1/2
Area of rivet hole, sq. in.	.2485	.3068	.3712	.4418	.5185	.6013	.6903	.7854	.8866	.9940	1.1075	1.2272	1.3530	1.4849	1.6230	1.7671
Shearing value of iron rivet (38,000 lb. per sq. in.)	9,443	11,658	14,105	16,788	19,703	22,850	26,231	29,845	33,691	37,772	42,085	46,634	51,414	56,426	61,674	67,150
Shearing value of steel rivet "A" (40,000 lb. per sq. in.)	9,940	12,272	14,848	17,672	20,740	24,052	27,612	31,416	35,464	39,760	44,300	49,088	54,120	59,396	64,920	70,684
Shearing value of steel rivet (44,000 lb. per sq. in.)	10,934	13,499	16,333	19,439	22,814	26,457	30,373	34,558	39,010	43,736	48,730	53,997	59,532	65,336	71,412	77,752

efficiency as well as to a seam requiring a wide inside welt like the diamond seam, some of these drawbacks being as follows: Accessories to a locomotive such as air pumps and reverse gears are fastened to the boiler shell by means of brackets, and it is almost always impossible to design these brackets so that the studs attaching them to the shell will permit of as high an efficiency in the shell sheet as 98 per cent, thereby making it necessary to apply diamond shaped liners to the shell underneath these brackets, in order to keep the efficiency through these stud or bolt holes up to the efficiency of the seam, which is absolutely necessary inasmuch as the thickness of the plate is generally based on the seam. The wide seam noted above also interferes with these brackets and liners, oftentimes making it necessary to put studs or rivets in the seam itself, thereby weakening it to below its theoretical efficiency. Especially is this true in the case of handrail post studs, which very often necessarily come in the seam. Unless the seam has some rows of high efficiency as the decuple seam rows *B*, *C* and *E* where these studs can be placed, the efficiency of the seam is impaired. The difficulty in locating attachments when wide welt seams are used, accounts for the sextuple seam being used on small boilers; that is, the smaller the boiler the harder to find place for attachments, and consequently here the seam with narrower welt works out the best.

The diamond seam is even more susceptible than the decuple seam to weakness at the inner row of rivets (marked *A* on Fig. 5) due to the higher efficiency and to the fact that the rivets must be placed close together in order to get sufficient rivets in the seam. The usual spacing of rivets in this row is about 3½ in. Assuming ¾ in. plate, 1 5/16 in. rivet holes, 98 per cent efficiency, the thickness of the two welts must be as follows:

$$\frac{3\frac{1}{2} \times \frac{3}{4} \times .98}{3\frac{1}{2} - 1\ 5/16} = 1\ 3/16 \text{ in.}$$

against ½ in. and 9/16 in. welts, or a total thickness of 1 1/16 in. for the decuple seam. This greater thickness of welts, coupled with the much wider inside welt, eliminates to a great extent, if not wholly, the saving in weight in the plate itself, due to the higher efficiency, and thus the reason for the use of this seam has been defeated.

Fuel and Locomotive Performance on the Central of Georgia

THE statement has been made that whatever tends to conserve locomotive fuel tends also to improve the general operating performance of a railroad. This seems to be borne out by the statistics of the Central of Georgia for the year 1921. During the year the railroad conducted a fuel economy campaign that developed a fine spirit of co-operation among the employees. The results in fuel saving were excellent. As shown in Table 1 the railroad saved more than half a million dollars during the year by improved locomotive fuel performance, this saving resulting in part from direct reductions in the fuel bill and to a lesser degree from incidental economies in operation as shown in the summary.

The spirit developed by the campaign on fuel saving has materially affected the operation in other ways and it is felt that it was an important factor in the excellent passenger train performance. Throughout the 12 months, 98.7 per cent of all passenger trains were on time. The operation of manifest freight trains was also improved, the percentage on time increasing from 76.5 in 1920 to 93.1 in 1921. Engine failures were materially reduced and the average mileage per failure rose to 57,572. Overtime was reduced to a remarkable degree, the overtime for enginemen and trainmen in 1921 being 23 per cent less than 1920. In yard service, overtime was 45 per cent less and in shops, 67 per cent less.

In announcing the results of the fuel saving campaign, the Central of Georgia Employees' Magazine makes the following comments:

"It is not necessary to state that this amount of money saved in coal has enabled the maintenance of equipment and maintenance of way departments to work more men and to use more material in the past year than would have been possible if this saving had not been effected.

"The credit for this fine performance is due to every one on the railroad who had anything to do directly or indirectly with the consumption of coal. By this time, as a result of the very intensive campaign on fuel economy, all of us are thoroughly familiar with the fact that practically every one on the railroad has something to do directly or indirectly with the question of fuel economy.

"At the various meetings which have been held by division committees on fuel and employees generally on the various divisions, the latter part of December, 1921, and the first part of January, 1922, resolutions have been made to the effect that every effort will be made to make a still greater saving in the year 1922. Fuel economy is a vital element in the operation of our railroad at this time; not only in respect to the direct saving as result of decrease in amount of coal used, but it has a direct influence on the prompt handling of business. The employees of the Central of Georgia are to be congratulated on the fine showing in the year 1921 as reflected by the figures given herewith."

Table 1—Analysis of Fuel Saving

Actual cost of coal 12 months ending December 31, 1921-1920, as charged to operating expenses

	12 Months 1921	12 Months 1920	Decrease
Tons of coal	511,520	637,412	125,892
Cost	$2,092,647	$2,741,133	$648,486
Average cost per ton	$4,091	$4,300	$0.209
Saved by better performance			91,254 tons

At an average of 50 tons per car, the detention of 1,825 cars was saved.
Figuring an average of 10 days per car, from mine back to mine, there were saved 18,250 car days.
Figuring an average of 28 cars per train at an average haul of 250 miles, there were saved the operation of 261 trains, also operating 32,625 locomotive miles.
Saving in car miles and ton miles based on average haul of 250 miles loaded cars and 250 miles empty back to the mine:

Car miles	912,500	..
Ton miles	36,503,750	

Summary Saving in Money

91,265 Tons of coal valued at	$350,999.47
18,250 Car days at $1.00 per day	18,250.00
36,503,750 Ton miles at actual transportation cost, or .0034 per ton mile	124,112.75
Locomotive repairs 32,625 miles at .30 per mile	9,878.50
Freight car repairs 912,500 miles at .02 per mile	18,250.00
Total saving	$521,399.72

Table 2—Passenger Train Performance, 1921

Month	Number passenger trains run	Number passenger trains on time	Percentage on time
January	2,937	2,867	98
February	2,656	2,592	98
March	2,941	2,888	98
April	2,850	2,816	99
May	2,814	2,779	99
June	2,792	2,763	99
July	2,814	2,780	98.8
August	2,820	2,802	99.4
September	2,722	2,706	99.4
October	2,811	2,795	99.4
November	2,803	2,779	99.1
December	2,935	2,889	98.4
Totals for 1921	33,895	33,456	98.7

Table 3—Comparison of Engine Failures, 1920 and 1921

Month	Number failures 1921	Number failures 1920	Miles per engine failure 1921	Miles per engine failure 1920
January	16	40	42,788	18,015
February	17	27	36,731	25,452
March	18	48	39,198	15,462
April	6	34	112,174	19,733
May	11	17	63,271	41,716
June	6	19	118,942	39,317
July	8	31	94,406	22,492
August	12	33	58,747	22,731
September	16	42	40,611	17,132
October	6	19	112,813	38,457
November	15	36	43,139	18,966
December	13	24	48,819	29,045
	144	370	Average 1921 57,572	Average 1920 23,798

Increase in average miles per engine failure, 1921 over 1920, 33,774 miles, or 58.66 per cent.

Handling Locomotives at Engine-houses*

By J. P. Gundaker,

28th Street Enginehouse, Pennsylvania Railroad, Pittsburgh

THE Twenty-eighth Street enginehouse at Pittsburgh handles from 160 to 180 passenger and switching locomotives each 24 hours in normal times. When a passenger train arrives at the Pennsylvania station, the locomotive is cut off from the train and run up to the inspection pits at Twenty-sixth Street, where it is inspected.

The defects found are reported on forms M. P. 62, and these forms are then sent through a pneumatic tube to the enginehouse office at Twenty-eighth Street.

Two clerks on each eight hour trick write up the work from the forms, M. P. 62 on work cards, M. P. 142 b, which are then sent to the storage yard through another pneumatic tube, if the locomotive has only minor defects; or if fire is to be drawn for repairs, the work is delivered by the work distributor to the gang foreman at the repair pits or to the gang foreman in the enginehouse.

After the locomotive has been inspected, the crew takes it to the ash pit where they turn it over to the enginehouse force.

The fire is then cleaned or drawn on one of the four pits, which are filled with water to within several inches of the base of the rail to reduce dust and gas and to quench the live cinders. The cinders are removed from the pits to cinder cars by an overhead electric crane with a clam-shell bucket.

After the fire is cleaned or drawn the locomotive is moved past the coal wharf where the tank is loaded with passenger coal and about five hundred pounds of low volatile coal is placed on the front of the tank to keep down the smoke while in the city limits, in accordance with a city ordinance.

After the coal is placed on the tank the locomotive is moved to the sand house and the water plug, where the sand box and the cistern are filled.

The locomotive is then run on to the turntable and headed in the direction in which it is next to be used, after which the hostler places it in the storage yard or on the repair pit.

The head inspector on the inspection pit marks on the bulkhead of the tank, in chalk, the destination of the locomotive for the information of the hostler.

The repair pits at Twenty-eighth Street, Pittsburgh, are three in number with a capacity of from twelve to fifteen locomotives, according to their classes or sizes. Light repairs, which require the locomotive to be jacked up, such as renewal of driving spring hangers, renewal of engine truck or trailer shells, or slight alterations to spring rigging, are performed on the repair pits. Also work which requires the fire to be drawn, such as flues or firebox calked or flues cleaned or light repairs in smoke box or to boiler valves, can be performed on the repair pits.

After the repairs to the locomotives are completed on the repair pits or in the enginehouse they are sent to the storage yard to remain until they are marked up and dispatched on runs.

Locomotives which are originally sent to the storage yard from the ash pits and which require only light repairs, such as tightening bolts and nuts, refilling grease cups, and repairs to piston rod or valve stem packings, are placed on one of the three pits in the storage yard until repairs are completed and then are lined up on one of the seven out-bound tracks.

After a locomotive is assigned to a run by the engine dispatcher the allowance of valve oil is placed in the lubricator by a locomotive preparer, the engine oil, to oil the machinery, and the cotton waste, to clean windows and lamps, are placed on the engine. The hand lanterns are filled with signal oil and the markers and torches are filled with carbon oil.

Eighty minutes before depot leaving time on a through passenger run, or 60 minutes before depot leaving time on a local passenger run, the engineer and fireman are required to report for duty and oil and inspect the locomotive and build up the fire. At 40 minutes before depot leaving time the engine is required to leave the storage yard and proceed to the depot, the fireman filling the cistern with water at the plug on the out-bound track.

Every precaution is taken to make the locomotives safe for the train employees and the traveling public. Two out-bound inspectors examine carefully every locomotive marked up for service and report any defects found to a gang foreman who sees that they are corrected before the locomotive leaves.

An assistant enginehouse foreman is present at all times to see that defects are corrected and locomotives dispatched promptly so there will be no delay to the trains at the depot and, so far as is humanly possible, no delay to trains on the road due to locomotive failures.

*Reprinted from the Mutual Magazine.

The Railway and Locomotive Historical Society

LESS than 100 years ago the first locomotive was placed in operation in this country. The development of the railroads which followed brought about such rapid progress that in half a century the continent was settled from the Atlantic to the Pacific and girded with a network of steel which so hastened its industrial development that within a short span of a century the American republic rivaled in wealth and power the leading countries of the old world. This is but one aspect of the influence of the railroads upon the progress of this nation. The complete story, if it could be told, would be more thrilling than fiction, of deeper significance than military campaigns or battles.

The history of the railroads in the United States is recorded only in fragments. There is no record of many of the important details of the early development and as time goes on the present knowledge will be lost unless carefully preserved. Here and there throughout the country will be found a few earnest workers whose interest in railroad history has led them to collect data on the early progress of rail transportation. In order to make their work more effective, about 50 persons interested in early railroad history have formed an organization under the name of the Railway and Locomotive Historical Society.

The first two bulletins of the society have now been issued, and contain some interesting articles which can be judged from the following titles: Yesterdays on the New York Central, The Story of the New England, America's Most Famous Train, The Fall River Line Boat Train, Eddy Clocks, Some Experimental and Historical Locomotives of the Chicago and North Western, The Rival Builders, the last named giving many important particulars of locomotives built by William Mason and the Taunton Locomotive Works.

Some of the data regarding these locomotives is noteworthy as giving an indication of the rapidity with which mechanical design progressed in the early period of railroad history and also as showing the extent to which the pioneer builders anticipated some of the most recent innovations in locomotive appliances. The changes in the type of valve gear furnishes a typical illustration. The early locomotives were built with V-hook valve motion. In 1855 William Mason built locomotives for the Toledo & Illinois with Stephenson link motion and in 1874 a locomotive for the New Bedford Railroad was fitted with the Walschaert gear. It was not until

30 years later that the Walschaert design was generally adopted. Other interesting items which may be worthy of mention are the following: William Mason locomotive No. 139, built for the Chicago, Burlington & Quincy in 1863, had a water leg in the firebox; No. 233, built for Toledo, Wabash & Western in 1866, had electric apparatus in the boiler to prevent formation of scale.

The officers of the Railway and Locomotive Historical Society are: President, Charles E. Fisher, Taunton, Mass.; vice-president, Herbert Fisher, Taunton, Mass.; recording secretary, C. W. Phillips, Taunton, Mass.; corresponding secretary, R. W. Carlson, Escanaba, Mich.; treasurer, A. A. Loomis, Jr., Berea, Ohio.

Interstate Commerce Commission Orders Power Brake Investigation

THE Interstate Commerce Commission, under date of February 20, has ordered an investigation to determine whether and to what extent, power brakes now in general use are adequate and in accordance with requirements of safety; what improved appliances or devices are available for use; and what improvements may or should be made. Hearing to be held at Washington, April 6.

A supplementary order was issued on March 4, addressed to all railroads reporting to the I. C. C., directing them to file a statement not later than the first day of April, 1922, covering the information called for below:

1. Copies of rules, bulletins and other instructions pertaining to operation, inspection, testing and maintenance of air brake equipment.

2. List of locations where facilities are provided for inspection, testing and repair of air brake equipment, together with a brief description of facilities and number of employees engaged in this work at each of such points.

3. List of locations where tests of pressure retaining valves are made, and description of such tests.

4. Statement showing location, length and gradient of all grades more than one mile in length and having a maximum gradient of one per cent or greater.

5. Description of practices in manipulating brake equipment for controlling trains descending said grades, showing types of equipment and brake pipe and main reservoir pressures used; limiting number of cars or tonnage for each of said grades; and speed limits specified.

6. Statement showing locations, if any, where trains are required to stop on said grades for the purpose of inspection of brakes or cooling of wheels.

7. List of accidents on said grades which occurred during the calendar years 1919, 1920 and 1921, resulting from failure properly to control speed of trains on grades, which caused personal injury, loss of life or property loss of $500 or more, together with number of injuries and fatalities and the property loss sustained by the carrier as a result of each such accident.

8. Statement for each of three years named, showing number of couplers broken, drawbars pulled out, and break-in-twos from other causes, together with derailments resulting therefrom, which occurred on said grades.

9. Statement for each of three years named, showing number of car wheels renewed for the following causes: (a) Burst, (b) Cracked, (c) Brake burn, (d) Slid flat.

10. Statement showing in detail to what extent, if any, hand brakes are used for controlling the speed of trains.

11. Statement showing what power brake equipment other than air brake equipment, if any, is used and extent of such use.

12. Number of accidents which occurred during the calendar year 1921, resulting in personal injury or loss of life from each of the following causes: (a) Burst or parted air hose, (b) Emergency application of air brakes, (c) Undesired quick action of brakes, (d) Train parting, (e) Faulty manipulation, and (f) Accidental interference with proper operation of brakes. Show the cause, number of injuries and fatalities in each case, and the total property loss sustained by the carrier.

13. Statement for the calendar year 1921, showing terminal and road delays to trains, due to causes attributable to improper manipulation or operation of air brakes or defective brake equipment.

14. Suggestions for improvement of air brake conditions or practices, and any other data which may be of value in connection with the commission's inquiry into this subject.

Action of American Railway Association

In connection with the above orders, the General Committee of the Mechanical Division of the American Railway Association at its meeting in Chicago, March 14, reached the following conclusions:

(a) That the time was not sufficient to assemble the data required; (b) that for the hearing on April 6 it is suggested each carrier send its representative to Washington with whatever information can be obtained by that date; (c) that the Committee on Safety Appliances of the Mechanical Division, consisting of C. E. Chambers (chairman), superintendent motive power and equipment, Central Railroad of New Jersey; C. E. Fuller, superintendent motive power and machinery, Union Pacific; W. J. Tollerton, general mechanical superintendent, Chicago, Rock Island & Pacific; J. T. Wallis, chief of motive power, Pennsylvania System; C. F. Giles, superintendent machinery, Louisville & Nashville, and T. H. Goodnow, superintendent car department, Chicago & North Western, be delegated to handle the matter for the association and that it be given any assistance necessary by the Train Brake and Signal Equipment Committee; (d) further, that the Committee on Safety Appliances be directed to advocate that present brake arrangements are satisfactory and that the percentage of mileage on grades is too small in proportion to total mileage to warrant any greater investment in brake appliances.

Subsequent to the meeting, it was requested that all information developed by each of the carriers and supplied to the Interstate Commerce Commission be forwarded to C. E. Chambers, superintendent of motive power and equipment, Central Railroad of New Jersey.

Deposition by Automatic Straight Air Brake Company

The Interstate Commerce Commission, in connection with its investigation of power brakes and appliances, ordered that upon application of Clark & La Roe, attorneys for the Automatic Straight Air Brake Company, the deposition of F. K. Vial of Chicago, with respect to the authorship and the subject matter stated in a certain communication addressed by him to H. I. Miller, president, Automatic Straight Air Brake Company, New York, N. Y., under date of September 20, 1918; and also with respect to the authorship of and the subject matter in a paper read before the Richmond Railroad Club, April, 1915, "The Chilled Iron Wheel," be taken before Examiner John T. Money, at the offices of said Vial, in Chicago, on March 20.

Power Brake Hearing Postponed

The Interstate Commerce Commission has postponed from April 6 to May 17 its hearing at Washington in connection with its investigation of power brakes and appliances; and the time-limit of its order requiring the carriers to furnish certain information regarding power brakes and appliances has been extended from April 1 to May 1.

Labor Board Announces Rules for Mechanics

ANOTHER new code of rules governing, in this case, the working conditions of employees who are members of the International Association of Railroad Supervisors of Mechanics, was announced by the Railroad Labor Board on February 28. The new rules, which are reproduced in full below, apply to the Baltimore & Ohio Chicago Terminal; the Boston & Maine; the Colorado & Southern; the El Paso & Southwestern; the Gulf Coast Lines, including the Beaumont, Sour Lake & Western, the Houston Belt & Terminal, the New Iberia & Northern, the New Orleans, Texas & Mexico, the Orange & Northwestern and the St. Louis, Brownsville & Mexico; the St. Louis Southwestern, and the Southern Pacific (Pacific System). They are effective March 1.

The new rules are as follows:

Rule 1. The term "supervisor of mechanics" as hereinafter used, shall be understood to include all foremen below the rank of general foreman supervising mechanics in the maintenance of equipment department.

Rule 2. All supervisors of mechanics, herein specified, shall be compensated on a monthly salary basis.

Rule 3. To determine the daily basis for all employees herein specified, multiply by twelve the regular monthly rate (exclusive of compensation for extra service), and divide the result by the number of days in a year that service has been customarily performed.

Rule 4. Monthly salaried supervisors of mechanics shall be required to remain on duty only a sufficient length of time after the shift of mechanics they supervise have completed their tour of duty, to properly turn over the work to their successors, if on a relief position; or if not on a relief position to see that there are no fire hazards and that everything is in proper place and order.

Rule 5. Supervisors of mechanics will not be required to report for work on Sundays, unless they have supervisory duties to perform, or when attending a conference in the interest of the service.

Rule 6. Supervisors of mechanics whose tour of duty consists of seven days per week, will be granted two days off each month. If for any reason the supervisor is not permitted to have two days off each month, he will be compensated for those days on the pro rata basis, in addition to the regular monthly compensation.

Rule 7. There will be no deduction in the compensation of supervisors of mechanics on account of shops working reduced hours.

Rule 8. The entering of employees in the positions occupied in the service, or changing their classification or work, shall not operate to establish a less favorable rate of pay or condition of employment than is herein established.

Rule 9. When a new position is created the rate of pay will be established to conform to positions of similar character and responsibility.

Rule 10. Foremen temporarily assigned to higher-rated positions will receive the higher rate.

Rule 11. When supervisors of mechanics are required to leave their established headquarters (which will be designated by superior officers), in compliance with the directions of superior officers, they will be paid necessary actual expenses while away.

Rule 12. Employees covered by this schedule and those dependent upon them for support will be given same consideration in granting free transportation as is granted other employees in service.

Rule 13. In filling vacancies or new positions, supervisors of mechanics senior in the service employed on a division or terminal making written application for such position, shall be granted preference where ability is conceded; the superintendent or master mechanic to be the judge.

Rule 14. When a position held by a supervisor of mechanics is abolished, advance notice thereof will be given, and so far as the management is concerned, he may resume his seniority in the craft from which he was promoted.

Rule 15. Efforts will be made to provide suitable employment for supervisors of mechanics who have given long and faithful service and have become unable, on account of age or infirmity, to handle their present positions.

Rule 16. In case a supervisor of mechanics accepts an official position with the carrier, or a salaried position as a representative of the employees, he will retain all seniority rights as provided for in Rules 13 and 14.

Rule 17. This agreement shall be effective as of March 1, 1922, and shall continue in effect until it is changed as provided herein or under the provisions of the Transportation Act, 1920.

Rule 18. Should either of the parties to this agreement desire to revise or modify these rules, 30 days' written advance notice containing the proposed changes, shall be given and conferences shall be held immediately on the expiration of said notice unless another date is mutually agreed upon.

The new rules are to apply to each of the above-named carriers "except in such instances as any particular carrier may have agreed with its employees upon any one or more of such rules, in which case the rule or rules agreed upon * * * shall apply * * *."

Referring to certain rules proposed by the employees, the decision says:

The Board has eliminated proposed rules relative to classification of shops, classification of supervisors of mechanics, and duties required in case of industrial disputes. These rules shall cease and terminate, except in such instances as any particular carrier may have agreed or may hereafter agree with its employees upon any one or more of such rules, in which case the rule or rules agreed upon by the carrier and its employees shall apply on said road.

All rules regarding the subject of discipline and grievances are left to the carriers and their employees for adjustment, the decision stating that a "substantial number of the carriers and their employees have agreed upon the major part of" these rules. The Board also adds:

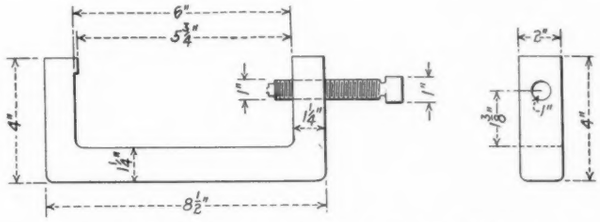
The Labor Board believes that certain other subject matters may not be covered in all localities by rules of general application, and require further consideration by the parties directly concerned.

Similarly the questions of vacations and sick leaves with pay are, according to the terms of this decision, remanded to the carriers and the employees for settlement.

Crosshead Blocking Clamp

By Leo. J. Welch

THE accompanying sketch shows a handy clamp, one or more of which should be carried in every locomotive engineer's tool box. The clamp is made to the dimensions shown and is intended to be used instead of wooden blocking whenever for any reason it may be necessary to disconnect the main rod and block the crosshead of a locomotive. The clamp takes up but little room and is as effective as wooden blocking, being applied to the guides just back of the cross-



Handy Clamp Facilitates Blocking of Crossheads

head and resting firmly against it with the piston at the extreme front of the stroke.

This clamp can also be used in case of broken guides, missing guide bolts or broken trunnion plates. When guide bolts are missing the clamp is applied to hold the guide against the cylinder block in such a way as to clear all moving parts. In this way, a locomotive can often be quickly fixed up to permit its movement to a terminal or the nearest repair point. The ready means of clamping the trunnion plate of a Walschaert valve gear may also prevent a locomotive or train delay.

WHAT OUR READERS THINK

THE editors of the Railway Mechanical Engineer *will be glad to receive communications for publication. This department is intended to reflect the views of the readers and the opinions expressed do not necessarily represent the sentiments of the editorial staff.*

Building Up Sharp Flanges by Gas Welding

PITTSBURGH, Kan.

TO THE EDITOR:

At the present time there is considerable discussion, pro and con, as to the desirability of building up sharp flanges on locomotive tires by autogenous gas welding. On the Kansas City Southern we use this method of reclaiming tires mainly where one tire in a set has become worn to the extent that it has reached our rejection limit. This is particularly advantageous where the tire that develops the sharp flange is near the rejection limit for thickness as it avoids turning down new tires which would otherwise be necessary.

Our method of doing this is to remove the tire from the wheel and place it on a trestle or face plate, flange down. Our experience has been that preheating the tire is not absolutely essential but it might tend to facilitate the operation if the heat was applied uniformly around the circumference of the tire. To heat the tire locally in a forge before laying on the welding metal will warp the tire. Our usual method is to start one or two welders on the tire without preheating. The welding metal is then laid in until the flange is brought up to contour and takes the gage full. The welder then makes use of a fuller and hand hammer to bring contour down to gage.

We find it best to use a welding wire higher in carbon than the tire itself. We have experimented to a certain extent with turnings from tires, drawing out and using these turnings instead of welding wire. Our experience with the turnings, however, has not been satisfactory and has been discontinued. After building up the flange, the tire can be turned if necessary. Our practice, however, is to mount the tire on the wheel and use an abrasive wheel-truing brake shoe in order to bring the tires down to normal contour.

This method has been in use on the Kansas City Southern for approximately two years and we have yet to find the first defective flange brought about by autogenous welding.

M. A. HALL,
Superintendent Machinery.

Unbalanced Steam Pressure on Pistons

COUNCIL BLUFFS, Ia.

TO THE EDITOR:

That the piston of a steam engine or locomotive may be subjected to unbalanced steam pressure, frequently of such amount as to be the cause of excessive friction and wear, is a possibility that evidently has not occurred to many designers. Such is the case, however, as will be seen on inspection of the accompanying cuts.

Fig. 1 is a sectional view of the type of piston used in the U.S.R.A. locomotives. The piston is built up of a central web and hub of cast steel, to which is riveted an annular bull ring of cast iron. That portion of the bull ring which is designed to run in contact with the bottom of the cylinder is made wider over a portion of the circumference, the periphery of the bull ring being extended to form a sort of slipper, the object being to increase the area of this part of the piston, upon which the weight is carried, thus reducing the unit pressure. The object is praiseworthy, but the ultimate results are far from what it was desired to attain.

This extended slipper surface projecting beyond the face of the piston is subjected to unbalanced steam pressure, for if it does what it is expected to do, i.e., run in actual contact with the cylinder wall, except for the film of lubricant which may or may not be present, then the steam is excluded from beneath the piston and acts only on the upper surface. The weight of the piston is therefore increased by an amount equal to the product of this projected area by the steam pressure. Thus, instead of reducing the unit pressure on the cylinder wall, it is actually increased three or four hundred per cent. The inevitable result is excessive wear, as an examination of cylinders where this type of piston is used will show.

Not only is the wear unduly severe on account of the increased pressure, but it is very apt to be much increased by a condition which enlarges the unbalanced area. After the wear has progressed sufficiently to open the space above the piston, as shown exaggerated in Fig. 2, the annular area of

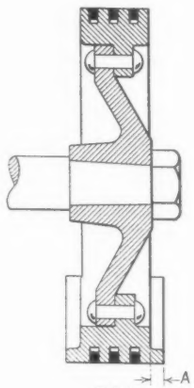


FIG. 1

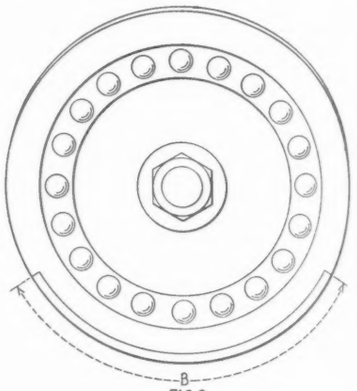


FIG. 2

that part of the upper surface of the piston, outside of the first piston ring, becomes unbalanced and the unit pressure on the cylinder wall is further augmented.

The remedy for the condition outlined above is obvious. It is to put the piston in the lathe and turn off the extended slipper portion.

The complete and absolute remedy for possible unbalancing of pistons is to support the piston centrally in the cylinder, as far as possible, and this can only be done by using extended piston or tail rods. It is also clear that the first ring should be close to the face of the piston and the face beveled back toward the first ring, to reduce the area of the annular space outside of the outer ring.

In addition it may be said that there is absolutely no necessity for the excessive amount of metal and consequent weight of pistons as usually designed. This excess weight is productive of a large share of the evils met with in operation of the heavier types of locomotives in use. Much of it is due to the fancied necessity for the use of three rings in pistons. A single ring of a positive seal type will undoubtedly give better service with less loss of steam than the three rings as usually applied. It will certainly afford an opportunity to dispense with considerable of the excess weight. It is also certain that with a reduction of weight, that many difficulties with lubrication will also disappear.

THOMAS E. STUART.

A Workman Expresses Himself

NEW YORK STATE.

TO THE EDITOR:

During the last year the *Railway Mechanical Engineer* seems to me to be a great deal inclined always to favor the railroads' supervisory forces. The mechanics and other workmen on the railroads are run down and criticized in nearly all points in their efforts to increase efficiency and economy.

There is some criticism due the mechanics but there is greater criticism due the supervisory forces—I firmly believe that a great many of them do not even know what the words efficiency and production mean.

I have worked at the mechanical game on the railroads as a mechanic and a foreman. I have made a close study of the situation and find that the one great wall to get over is that the under foreman—and other small officials as they are classed by the management—have pulled the wool over the superintendent of motive power's eyes for so many years that they have the idea that they can do so indefinitely.

Their effort toward keeping the power on the road is all right but (here is that one little bad feature "but") they overdo themselves and only do half of the work and send the running stock out to break down on the road just to show that the engine or car, whichever it may be, was put in service when it was promised to the master mechanic.

If I had the right of free speech I would criticize the under subordinate officials till they had to get out and produce the goods or vacate. But as the situation is at present the railroad officials can see nothing that a workman may remark or propose, if there is one thread of criticism toward any of the officers.

I hope some official will come back at this letter with an answer; I believe my points can be easily proven without in any way crippling the power on any railroad. I believe if the railroads would come half-way and show a little co-operation with the men, and not try to trick them at every move, there would be far better results. MECHANIC.

The Possibilities of High Power Internal Combustion Main Line Locomotives

LONDON, England.

TO THE EDITOR:

I have read with a great deal of interest your article on the above subject on page 120 of the March issue. Whilst quite agreeing with many of the remarks so clearly given therein, I must draw your attention to the defects of the so-called Diesel locomotive.

Although it is true that locomotives have been built and operated in Europe in which the prime mover has been a Diesel-cycle, internal-combustion engine, they have not been satisfactory in any sort of way; in the first place they are much too costly and heavy, the danger of broken crank-shafts has been amply demonstrated, and as a hauling machine for main line traction the Diesel is out of the question and only a waste of money to further use it. It is true also that the constant pressure internal combustion engine has been now brought to such a state of perfection that the time has arrived when a serious attempt is being made to increase the capacity of our railways by the introduction of internal combustion main line locomotives of high power.

This work I have had the pleasure of carrying out and at the present time am constructing two standard gage locomotives for demonstrating purposes. Laboratory tests have indicated that there will be a saving in fuel per 1,000 tons hauled at given speed and other conditions of no less than 75 per cent as compared with oil fired ordinary superheated steam locomotives, of which I have had also considerable experience during the last 20 years. The internal combustion engine, which is embodied in the new Paragon internal combustion locomotives is known in this country as the super-Diesel oil engine and is the result of some 30 years' experience in many types of internal combustion prime movers, closely studied with a view to the ultimate application of same to heavy railway haulage.

The exhaust is silent, the temperature of same is very low and the thermal efficiency far exceeds that of any Diesel-cycle engine whether of the two or four stroke type. One of the two locomotives under construction is fitted with my variable voltage electrical power transmission of special design for driving the axles, and is of the 0-4-4-0 type and the tests will be made in a few months' time on a 1,000-ton freight train.

The other locomotive is of equal power as regards the internal combustion engines, but in this case steam is used as the medium for transmitting the power of the internal combustion engines to the driving axles, so that all the tremendous advantages of steam are still retained for speed regulation, reversing and operation purposes, whilst the use of internal combustion means as the prime source of energy gives now a new and long lease of life to the steam locomotive even against electrification for trunk line operation.

For the purposes of the experiment we have taken one of our standard 14 in. by 22 in. six-wheel coupled standard steam locomotives, put her under the crane, lifted the boiler, superheater, pumps, injectors, etc., off, disconnected the tender (as this of course is not now required), and in the place of the ordinary steam boiler we are installing a set of Paragon internal combustion engines which drive a Paragon specially constructed steam compressor. Steam is first made in a small flash type steam generator (about 30 gallons of water used), and this small amount of steam is raised to about 16 lb. gage pressure. The internal combustion engines are then started, which driving the Paragon compressor, draw the low pressure steam and compress it (in this case to 180 lb. per sq. in. gage pressure), the steam is then admitted through the ordinary throttle and cutoff gear to the working steam cylinders, the tractive effort is produced (same as when the boiler was installed), the exhaust steam, however, does not exhaust to the atmosphere, it exhausts to the low pressure side of the system and is drawn in and recompressed by the Paragon steam compressor, and transferred with all its latent heat to the high pressure side for use again.

The Paragon is now nearly completed, the compressor has been tested and a very high thermal transformation efficiency has been obtained, sufficient to warrant me for stating that we estimate a rail horsepower thermo-dynamic efficiency of quite 25 to 30 per cent, which compared with many types of oil-fired steam locomotives, indicates a fuel saving of 75 per cent, which will simply chase off the earth any scheme of electrification in the ordinary way.

The Paragon electric steam locomotive system is a further development of the previously mentioned invention, and consists of means by which existing steam locomotives may be converted and operated on electrified railways, and with greater economy than with high class ordinary electric locomotives. The mechanical energy given by the electric motor is first transformed into steam heat energy by the compressor; it is then re-transformed into mechanical energy by the working cylinders, which produce the tractive effort, expanding and cooling the steam in the process, the exhaust steam is then taken by the compressor and is re-compressed by means of the electrically driven Paragon steam compressor, ready for use again, continually flowing at various pressures and temperatures in a close circuit, no discharge to the atmosphere.

A feature also demonstrated during my experiments, is that on running down grades the kinetic energy of the locomotive and train is arrested and transformed into electrical energy which is returned to the line, also with a much higher efficiency than with ordinary locomotives.

WILLIAM P. DURTNALL.

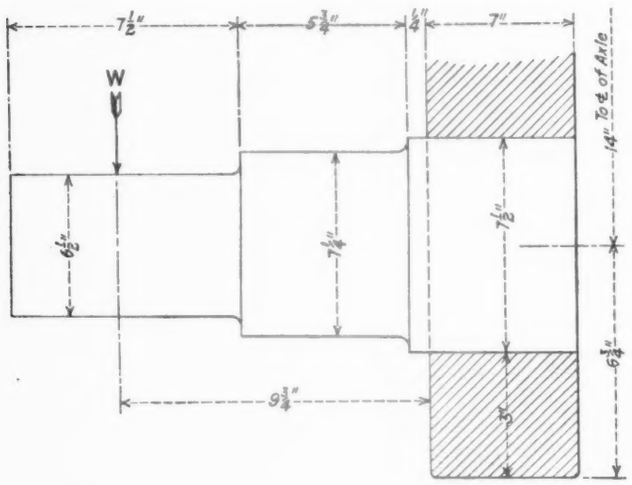
THE QUESTION BOX

WHEN a question arises that you cannot answer, what do you do? Some of the readers of the *Railway Mechanical Engineer* refer knotty problems to the editorial staff and the editors always try to answer inquiries insofar as their numerous other duties will permit. It has been suggested that a department of questions and answers would add value to the paper and in order to see whether it would be popular with our readers, the Question Box has been started.

The editors will try to get answers for any questions sent in. Probably more problems will be submitted than can be handled by the limited staff. Some may deal with matters that only a specialist is competent to pass on. Such questions will be submitted to recognized authorities in the respective fields, or will be referred to our readers. It is hoped that those who are able to supply information will help by sending in replies. This is, in a special sense, your department. The benefits you derive from it will depend on the interest that you show. We hope you will help to make it of value both by sending in questions and by co-operating in answering the inquiries published.—*The Editors.*

Design of Crank Pin and Crank Pin Hub

Question.—Referring to the sketch attached, please show the method used in arriving at the following data needed in design: (1) Fibre stress in the crank pin hub due to pressing in the pin with a pressure of 140 tons; (2) maximum pressure at which the crank pin can be pressed in without



causing the hub to burst; (3) fibre stress in the hub due to pressing in the pin at 140 tons, plus the stress due to the thrust from the main rod (cylinders 25-in. diameter by 28-in. stroke, boiler pressure 180 lb. per sq. in.); (4) find the strength of the pin to resist the load W.

The wheel center is of cast steel and the pins are carbon steel forgings, both conforming to the specifications of the Mechanical Division of the A. R. A.—P. F. R.

* * *

The Railway Mechanical Engineer invites answers to the above problem. The best solutions will be published and paid for at the usual space rate.

Automatic Couplers

Questions.—

1. When were automatic couplers first applied to freight and passenger cars?

2. To what extent were automatic couplers applied before their use was required by law?

Answers.—

1. The Janney coupler was invented in 1873; the Miller hook was developed about the same time and was applied to a large number of passenger cars prior to 1880.

2. A large number of different types of automatic couplers were applied before their use was required by law and practically all passenger equipment was fitted with some type of automatic coupler before 1889. Automatic couplers also came into use extensively on freight cars a few years later. A summary included in one of the early reports of the Interstate Commerce Commission shows the per cent of freight cars fitted with automatic couplers was as follows: 1889, 6 per cent; 1890, 8 per cent; 1891, 12 per cent; 1892, 16 per cent; 1893, 22 per cent; 1894, 26 per cent; 1895, 31 per cent; 1896, 38 per cent.

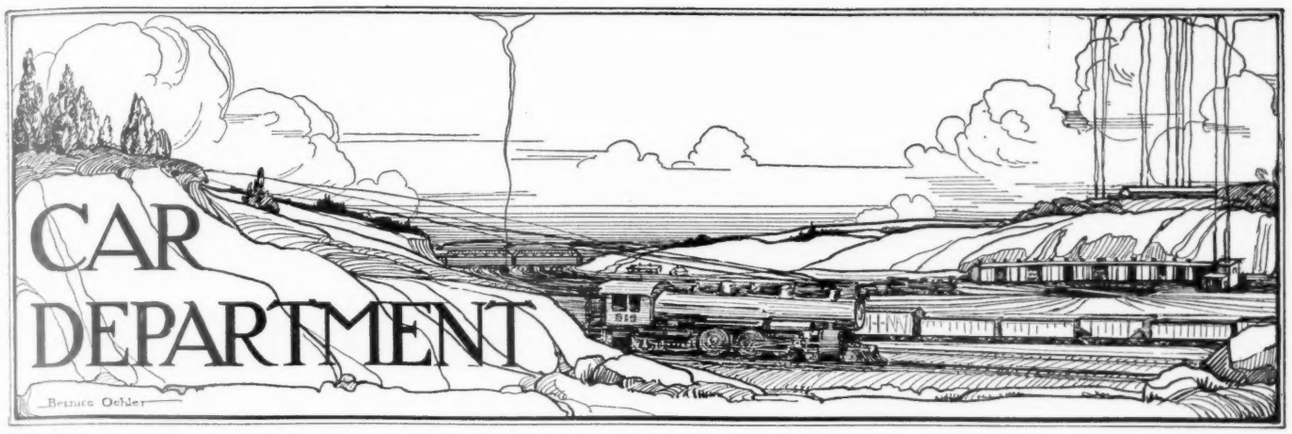
AIR BRAKE CORNER

Failure of Driver Brake to Release After Independent Application

Question.—Would like information on a question raised by several engineers regarding an action which sometimes develops in E. T. operation. In several cases it has happened that when an independent application of the brake is made, the brake will not release when the independent handle is moved to running position, the automatic handle being in that position also. To effect an independent release, it was necessary to place the independent brake handle in release position.—A. W.

Answer.—The action mentioned above is due to the equalizing slide valve of the distributing valve being in lap position. It was moved to this position probably because the distributing valve was overcharged, though possibly, perhaps, by a feed valve fluctuation. The overcharge would have been caused by remaining too long in release position and should be overcome by a kick-off some few seconds after returning from release to running position. Whether the kick-off has returned the equalizing piston to release position can be tested by making an independent application and then placing the independent brake valve in running position. If the driver brakes release, it is evident that the equalizing piston is in release position. If the driver brakes do not release under this manipulation, another kick-off should be given.

If the driver brakes creep on while running along the road, they should not be released by use of the independent brake valve but should be released through the automatic brake valve; that is, make a kick-off which will return the equalizing piston and slide valve to release position. If the driver brakes are released by the independent brake valve, on account of creeping on, they will continue to creep on until the equalizing piston is returned to release position.



Discussion of the New Rules of Interchange

Prices and Labor Rules Given Close Attention at Car Inspectors' and Car Foremen's Meeting

PROCEEDINGS of the Chief Joint Car Inspectors' and Car Foremen's Association meeting at the Great Northern Hotel, Chicago, January 9, were published in the February and March issues of the *Railway Mechanical Engineer,* with the exception of Rules 107, 108, 112 and 120. The discussion of these rules is taken up below.

Rule 107

C. J. Wymer (C. & E. I.): On this journal box here, on this labor, Item 220 says there shall be charged so much labor for renewing journal boxes in connection with certain work. Item 222 says, "Journal box, renewed, in connection with wheel renewals, including lids and dust guards." Nothing is said about the lid on any other combination. I do not understand why it makes specific mention of the lid in this case.

W. J. Owen (Peoria, Ill.): The charge in connection with wheel renewals, including lid and dust guards is for the labor required to get the box, apply the lid and apply the dust guard. If you renew the wheels you have got to remove and replace the old journal box. This .5 hour is for applying a lid and dust guard and getting the new box. Item 220 does not refer to boxes applied when the wheels are renewed. It shows the new boxes applied to the truck.

Mr. Watkins: Referring to Item 223, if you use .3 hour for the journal box lid and if .5 hour is allowed for lid and dust guard, don't you use .2 hour for applying a dust guard?

Mr. Owen: The .2 hour is for applying the dust guard and getting your journal box raised. The Rule 223, .3 hour covers the application of the journal box lid only.

Mr. Jameson (Southern): Item 5B reads: "Altering height of car by shimming springs, charge for material used and labor as per item Number 401 of Rule 107. This charge also applies to the renewal of shims." Turning to Item 401 I find not only 401 but 401A which covers truck springs under different conditions. I would like to ask if it was really not the intention to include reference to both of those items in item 5B. In other words, I should get the same labor allowance for applying truck spring shims that I would have for applying a truck spring.

M. E. Fitzgerald (C. & E. I.): I see no reason why if in the application of shims you find it necessary to remove the bolts you should not charge in that manner. The rule does not say exactly that, but I think anyone would accept the bill. If the construction of the car was such and your original record showed that you removed those bolts, you would be justified in charging according to 401A.

Mr. Owen: That is the manner in which we have handled 401 and 401A since the time it was issued. A number of roads took issue with us on that but they finally conceded that we were right the same as under items 420, 420A, 420B or 420C on the application of wheels.

Mr. Jameson: *I move that it is the consensus of opinion of this association in this session that Item 5B was intended to cover both items* 401 *and* 401*A.*

Mr. Martin (B. & O.): In order to charge according to 401A it is necessary to show that it was necessary to remove the column bolt and that will control your whole charge. I do not think the motion is necessary at all if you have proper information shown on the repair card.

Mr. Fitzgerald: The difference between an ordinary car and a refrigerator car in 401A is 2.5 hours for the ordinary car and 5.2 for the refrigerator car. There would be no difference.

Secretary Elliott: I do not agree that there isn't any difference, because there is a difference.

Mr. Jameson: It is suggested that I should add *"On ordinary box cars"* to the motion. The reason for that is that evidently there must be a misprint in Item 401A because he quotes 2.5 hours for ordinary cars and 5.2 for refrigerator cars, the figures just reversed. I have no other idea than that was just a printer's slip. If we make it ordinary cars that will avoid the question.

President Pendleton: That is added to the motion.

The motion as revised was carried.

Mr. Lennertz (B. & O.): I cannot find any labor for truck spring plank in connection with a bolster, on a swing motion truck, in Item 32.

Mr. Owen: I believe Item 32 has reference to bolster in what is known as a Player truck frame where it is unnecessary to put in springs or anything else,—just lift the bolster and apply a new one.

Mr. Morrison: Cases of that sort can be very readily settled on the ground by building up the charge by showing the individual operation where no arbitrary labor charge is given for any particular operation that a man has to cover. You can very readily arrive at a correct total in that manner.

Mr. Fitzgerald: In the case of a spring plank alone he could turn to page 141 (1921 code) and would find labor prices for the spring plank and if that did not cover it then he would have to key it.

Mr. Jameson: Mr. Lennertz should use Item 433, "The R. & R. or R. of all items not specifically covered in these rules, which are secured by bolts, nuts, lags, screws or rivets, to be charged on that basis.

T. S. Cheadle (Richmond, Va.): The spring plank of that construction that I have noticed has neither bolts, rivets nor lag screws.

Mr. Jameson: Item 45 covers labor for renewing or removing and replacing brake beams. It gives us an arbitrary charge of 1.2 hours. It states that it covers the three key bolts. There are a good many of the roads now that are charging an additional key bolt when the beam hung with the live lever is R. & R., stating on the billing repair card that it was necessary to R. & R. one key bolt in the dead lever to obtain slack. I think it is a just charge, but it is not generally practiced.

The same thing applies to a bottom rod. The ordinary thought is that it has two key bolts, one at each end of the bottom rod. If the brakes are adjusted properly it is necessary to obtain slack on the dead lever guide, which brings about three key bolts. In such cases where it is necessary to R. & R. an additional key bolt you should have the right to charge it.

I move that it is the consensus of opinion of this body that where it is necessary to R. & R. an additional key bolt with the application of the brake beam or a bottom rod that such a charge is justified.

Mr. Owen: Item 67 on page 128 reads: "Brake connection pin or key bolt, any length, R. & R. or R., separately, each 0.2 of an hour." If you had to R. & R. any additional key bolts it seems to me that item clears it up so that you will get pay for it.

Mr. Fitzgerald: Rule 107 reads:

> The following table shows the labor charges which may be made for performing the various operations shown. The labor allowances include all work necessary to complete each item of repairs, unless the rules specifically provide that in connection with the operation additional labor may be charged.

That article specifically includes the items that you may charge for. You may have to take out the other key bolt but the rule states just what you shall charge and if you are going to make any additional charges you would be letting the bars down for a lot of variations in the prices.

Mr. Martin: I agree with our Southern friend over there. This item states just what it covers and if there is an additional key bolt taken out you are entitled to the .2 hour.

The motion was carried.

Mr. Cheadle: In reference to Item 45, it states that the R. & R. or R. of the safety guards are not included. There are two types of safety guards, so-called by men who repair cars in my territory. There is one that goes around the beam and is fastened with bolts. There is another that goes through the spring plank. Item 51A gives the charge for brake beam safety guards renewed, and makes a charge on a bolt or rivet basis, plus jacking the car if necessary. Some so-called safety guards are not secured by any bolts, rivets or lags. I had in mind that the rule would probably permit a charge for that.

Mr. Owen: The renewal of the brake beam, item 45, would not include the removing and replacing of the safety hanger. That is the way I interpret it.

Mr. Cheadle: In the case of a spring plank guard, there is no charge in the book for one of that kind.

Mr. Fitzgerald: There is no charge in the book for actual labor. The rule tells you that.

Mr. Jameson: Item 89: "Journal box bolts, renewed." These are ordinary journal box bolts. Now we have a kind of journal box bolt that is new to most of us.

Secretary Elliott: The Vulcan truck frame.

Mr. Jameson: The lower part of the journal box is detached from the top part, and is secured to it by four and sometimes six small bolts less than six inches long. I would like to know a repair charge for these bolts. They are not horizontal box bolts, neither are they journal box bolts referred to in Item 89.

Mr. Owen: I believe that Item 90 will cover that.

> Bolts, 6 in. or less in length, not otherwise specified R. & R. or R., each 0.2 hours.

Secretary Elliott: The bolt you have reference to is not a journal box bolt as we know it. It is a tie bolt.

Mr. Jameson: It is common practice among the men to call it a journal box bolt. As all our billing clerks are not practical car men they take it as a journal box bolt.

President Pendleton: We will have to educate the clerk.

Mr. Jameson: Item 227, page 137 reads:

> Ladder, metal or wooden, complete, renewed; to be charged on bolt or rivet basis.

We have many ladders, both metal and wooden, in which the bolt is put in from the inside of the car and it is only necessary in renewing broken stiles and repairing metal ladders to R. &. R. the nuts, yet according to this item we would disregard the real operation and charge for it on the bolt basis. I think bolts are better put inward in some cases. Perhaps they are going to try to educate us to do it in that way.

Secretary Elliott: The law would not permit you to do that in most cases. The nuts have got to be on the outside.

Mr. Jameson: Then why should I be privileged to charge bolt labor when I only R. & R. a nut?

A. Herbster (N. Y. C.): I think that can easily be explained. They are trying to save all the bolts they possibly can. If they pay you as much labor for the nut as the bolt then you have lost that much material.

Secretary Elliott: A sort of premium for saving the bolt.

Mr. Jameson: Then the committee's real intention was that we should charge on a bolt basis and did not omit the word nut; is that right?

Mr. Herbster: Yes.

Mr. Fitzgerald: In the majority of cases you have to destroy the bolt anyway. Further than that, in handling the ladder, there are many types of ladders and there is additional labor in handling the ladder and this rule I think was written to cover some additional labor. For instance, you look at 211, which covers only a hand hold and where there is a possibility of saving the bolt they refer to the charge on bolt, nut or rivet basis.

Mr. Owen: I think the whole intent of that rule, as far as labor is concerned, is to make that charge in accordance with the number of bolts that you had to remove the nuts or remove the bolts to do that work. If the bolts were not renewed you would not have the privilege to bill for the material that was in the bolt but you would for the labor, whether you removed the bolt or the ladder from the bolt.

Charles Claudy (Grand Trunk): I was on the sub-committee and I think they have omitted the word nut. I think it was overlooked.

Mr. Jameson: *I move that it is the consensus of opinion of this body that Items 227 and 228 mean just what they say, on a bolt or rivet basis and that nuts do not enter into consideration.*

The motion was seconded and carried.

Mr. Watkins: It has been the practice of the Hocking Valley to charge for removing and replacing nuts like that. We have taken exception to bolt charges where the nuts only were removed and received offsets after a time.

The Chair: You should have taken exception to that

and gotten off with it. You do not find once in a hundred times a case of that kind would happen.

Mr. Jameson: Referring to Items 5B and 401, I would like to know what the proper labor charge is for the renewal of one or more truck springs, and at the same time, in the same location, the removal of a shim.

Mr. Owen: You can only make the one charge in so far as labor is concerned. You can charge additional for all the material you use.

E. S. Swift (Wabash): Item 18 reads:

Arch bar tie strap, continuous one R. & R. or R., including R. & R. or R. of nuts, only, 1.4 hours.

Suppose we had to remove a column and box bolt in connection with the tie bar from that column and box bolt, they would exceed the charge for the tie bar.

Mr. Fitzgerald: You would not bill for the tie bar. You would charge for the bolts.

Mr. Watkins: In removing journal box bolts and tie bars at the same time, would not 431 apply and reduce the bolts by one-tenth of an hour? Item 431 reads:

When the nut or nuts on any bolt over 6 in. in length is removed in connection with overlapping repairs, the labor charge for that bolt, if renewed, shall be reduced by 0.1 hour.

Mr. Cheadle: Is it permissible to add the jacking of the car to Item 18 when jacking is done? The strap is simply slightly sprung, not enough to require its removal.

Mr. Owen: An additional charge for jacking the car would be permissible.

Mr. Jameson: I have a case of overlapping labor under Items 40, 237A and 416.

Item 40—Body truss rod, perfection, R. & R. or R. (includes handling only, exclusive of turn buckle and nut) 1.6 hours.
Item 237A—Nuts, body truss rod, one or more on same rod, R. & R. or R., empty or loaded car, includes tightening rod, per rod, 0.6 hours.
Item 416—Truss rod or other turn buckles, R. & R. or R., empty or loaded car, includes tightening rod, per turn buckle, 0.6 hours.

I tightened that rod twice, I have been told that was perfectly plain and there wasn't any overlapping labor at all; that you first tightened the truss rod with the nut when you put it on the end, and then you went to the turn buckle and tightened it again. I believe that if you tighten the rod you tighten it both at the nut and turn buckle. I believe there is overlapping labor there. Item 237 should be clarified by inclusion with Item 416. It should be one-tenth of an hour the same as other nuts.

Mr. Claudy: We spent about four days on that body truss proposition and we still have a lot of questions to answer and the question is coming up day after tomorrow. We do not know just where we stand yet. The question is coming up again.

President Pendleton: We will hear further from the committee, then.

Rule 108

No labor to be charged for the inspection of cars, testing or adjusting brakes, adjusting angle cocks, tightening unions, bolts, bolt nuts, lag screws or spreading cotters; sill steps, ladder treads or handholds, tightening or straightening on car; brake shafts, uncoupling levers *or carrier irons* straightened when not removed from car.
No charge to be made for the material or labor of lubrication.

Mr. Fitzgerald: I would like to ask if there is any possibility of us making a charge if we do lubricate and properly stencil as per Rule 66? It does not say in this rule that I cannot charge for stenciling boxes packed.

E. H. Mattingley (B. & O.): I would say if Mr. Fitzgerald repacked all of his boxes and applied the necessary stenciling he would be entitled to a billing charge for the stenciling only.

Mr. Fitzgerald: I do not think you are entitled to any labor charge but I brought it up because we are going to have bills presented.

Mr. Martin: In view of the fact that the committee has not given us a labor charge for the packing, I do not think there is any charge for the stenciling. It does provide a charge for stenciling to preserve identity.

President Pendleton: I do not believe there would be any charge for stenciling if you repacked the box. However, I think that we should live strictly up to the rule and perform that work.

Rule 111

Mr. Jameson: The charge for Item 23 last year was thirty-six cents. The item now as it is revised allows a charge of 25 cents but does not show the R. & R. of retaining valve. It reads: "Retaining valve, cleaned and tested on or off car." I am of the opinion that you would still charge R. & R. of the retaining valve, which would be one connection where the rule raised the price just where it was before.

Mr. McGrail: Supplement number 1, issued in 1920, effective July 1, 1921, reads as follows: "After date July 1, 1921, Item 23 is modified to read as follows: Retaining valve cleaned and tested on or off the car, twenty-five cents." That rule has been in effect since the first of last July.

Mr. Fitzgerald: That does not include the removal and replacement.

Mr. Martin: There was quite a lot of discussion or contention about that charge when it did not show as explicitly as it does now, and the committee in order to clarify it reduced the charge of one connection. Now they have turned around and included it in the rule to make it very plain that the retaining valve on or off the car is a net charge.

Mr. Fitzgerald: Item 4 reads:

Connections: Pipe, pipe fittings, air hose, angle cock, cut-out cock, release valve, retaining valve or strainer, R. & R., for each connection made (disconnected and connected or connected only), eleven cents.

Wherever labor is included it particularly specifies in this rule that it is merely a labor charge for the cleaning. I do not think it includes the R. & R. if you remove the valve.

A. S. Sternberg (Belt Ry. of Chicago): What Mr. Fitzgerald refers to is removing retaining valve to make some other repairs and putting it back. It does not refer to the cleaning.

Mr. Jameson: In the 1920 rules, the item read: "Retaining valve R. & R. and cleaned only, 36 cents." It was the practice in many places to clean the retaining valve without removing it from the car. At that time we made a practice of charging 25 cents for cleaning the retainer on the car when it was not removed, deducting 11 cents, the proper charge for the connection, because we did not perform that part of this item. Now the connection is entirely eliminated.

Mr. Watkins: We have been billing under this rule since the change was made, and we have always added 11 cents for the connection and never had an exception taken.

Mr. Jameson: The note under Item 4 says: "No additional labor charge to be made for lag screws or bolts in retaining valve R. & R. when a valve is renewed, repaired or cleaned," giving you the pipe connection, clearly.

I move that it is the consensus of opinion of this body that one connection should be added to Item 23 when it is necessary to R & R. the retaining value.

The motion was put and carried.

Rule 112

C. S. Shearman (Chicago): Our line is a switching line and the home of a large number of refrigerator cars. I note the price on the refrigerator car is around $4,400. The present market price on that same class of cars is around $2,750 or $2,800. That places us in a pretty hard position settling for that kind of equipment.

Secretary Elliott: It is that way on all cars.

Rule 120

Mr. Watkins: Interpretation No. 2 under this rule reads as follows:

Q.—In the case of owner's responsibility for repairs where the total labor charge exceeded the limits specified in Rule 120, if in result of an oversight

or underestimate the car was repaired without taking up the case with the owner under Rule 120, what settlement should the owner make for the repairs?

A.—In such case the total labor charge should be reduced to the limit allowed on the car by Rule 120, and the same percentage reduction should be made in the total charge for material.

We have a case where the labor limit on one of our cars, under section (b), was exceeded by $500. The car was a 40-ton gondola, with a labor limit of $108. We reduced the charge by figuring the percentage reduction from the total amount of the labor, or $158, which made 31.7 per cent reduction, and the road took exception to that, saying that the percentage should have been figured with $108 as the base, which would have made the percentage 46.1, we applied the 31.7 per cent reduction to the material charge. The repairing line through some oversight, did not estimate it under Rule 120.

Mr. Sternberg: I understand that the bill is $158 and they exceeded the limit by $8. The rule says: "In no case shall the total charge for actual repairs exceed the estimate by more than $50."

J. J. Gainey (Southern): You are getting two cases mixed. In one you write an estimate to the car owner and if you make a mistake in your estimate you have a perfect right to go $50 beyond that and get paid for it. In this other case, if a foreman estimates he can repair a car within $108 labor charge and then runs to $158, he has to take that $50 off the bill.

Mr. Watkins: Then the question is, how should the percentage reduction in the material charge be figured?

Mr. Owen: I think this rule clears that all up at the present time. If you have an overcharge over what Rule 120 allows, you are supposed to reduce your labor charge to the Rule 120 specifications. If it is 35 per cent or 37 per cent then you are to reduce your material charge 35 or 37 per cent.

Mr. Swift: That is not answering the question. I want to know whether the percentage is based on $158 or $108?

Mr. Owen: $158. You would reduce it by the percentage that $50 is of $158.

Mr. Swift: Section (d) says: "In no case shall the total charge for actual repairs exceed the estimate by more than $50 (exclusive of betterments) unless authorized." When you report a car under Rule 120, you report the material and labor separately. Is that rule intended to mean that if the total material and labor charge is over the $50 excess you would reduce it to the $50 even?

President Pendleton: I think that if you exceeded $50 you would have to make your reduction down to that limit.

Mr. Gainey: I do not believe you will have any case of that kind. The trouble I have found is that the estimates always run $200 or $300 above what it costs to actually repair the cars.

R. A. Kleist (B. & O.): The new paragraph added to Section (e) says in part:

Couplers, wheels, axles and journal bearings shall be credited on basis of scrap prices shown in Rule 101 for such items.
renewed, shall be reduced by 0-1 hour.

In Interpretation No. 5, under Rule 101 the question is asked as to what scrap credit should be allowed for couplers removed from dismantled cars. The answer is: "In settling for the salvage of dismantled cars a scrap credit price of one-half cent per pound to be allowed for couplers." I would like to have the apparent conflict explained.

Mr. Wymer: The items in Rule 101 cover repairs to cars. Rule 120 refers to dismantling cars and you follow the interpretation under Rule 101.

Mr. Owen: I believe there is a misinterpretation there. Item 113, Rule 101, covering rough cast steel, has a credit of half a cent a pound. Interpretation No. 5 covering the coupler also says a half a cent a pound. But that is not to be used under Rule 112 in case the car is destroyed on a foreign line; it is to be used in the case of an old car written up for disposition, of which you have to allow for the actual scrap or salvage of the items in the car and not on a pound basis.

Mr. Fitzgerald: I think then that Rule 120, paragraph (e) should read: "Settlement to be made as per interpretation on page 114 of Rule 101."

Mr. Owen: Going over the coupler items in Rule 101 you will find different prices for different size couplers. It appears to me that these prices for scrap couplers are based on a weight basis and that if they were figured out you would find they were pretty close to a half cent a pound, I do not believe there is much variation.

W. M. Herring (Southern): The interpretation as shown under Rule 101 in the new rules on page 114 is obsolete and I am satisfied it was put in unintentionally, because it was based on old Rule 120 which did not make specific reference to couplers in the allowance for credit on dismantled cars.

Mr. Kleist: I think that in putting this new paragraph under Section (e), Rule 120, the committee overlooked eliminating the intepretation which is given on page 114 of the old rule.

I move that it is the sense of this meeting that under Rule 120, second paragraph of Section (e), couplers should be credited on the basis shown in the table in Rule 101.

The motion was seconded and carried.

Resolutions

The following resolutions in tribute to the memory of Henry Boutet were presented by a committee of which T. J. O'Donnell, Albert Kipp and W. P. Elliott were the members:

The membership of the Chief Interchange Inspectors' and Car Foremen's Association in general session in conjunction with the meeting of the Executive Committee in Chicago, January 9, 1922, takes cognizance with profound sorrow of the death of one of our most active and influential members, Henry Boutet, Chief Interchange Inspector of all lines at Cincinnati, Ohio, which recently occurred, and has inscribed in the records of the Association the following tribute to his memory:

Whereas: The Great Creator in his infinite wisdom and mercy, has seen fit to call to his last reward our esteemed associate and beloved friend, Henry Boutet, whose service for upwards of 25 years and untiring efforts has placed the Association on the plane that it has reached and whose never-failing geniality deeply endeared him to each and every one of its members; now, therefore, be it

Resolved: That the membership of the Chief Interchange Inspectors' and Car Foremen's Association of America, very deeply feel the loss sustained in the death of Mr. Boutet and we extend to his bereaved family and relatives our heartfelt sympathy in this their hour of sorrow and affliction, and we earnestly hope that an all-wise Providence may soften the blow which has fallen upon them and that Time, the great healer, will enable them to realize that their loss and our loss has been his gain, in that he has attained that Eternal Home where no suffering or sorrow intervenes.

It is Further Resolved: That a copy of this resolution be submitted to the sorrowing family and that a copy be spread upon the Minutes of our meeting.

Deplorable Condition of Russian Railroads

The Russian railways are in a deplorable condition owing to the lack of supplies. On January 1, 1917, the serviceable mileage was approximately 44,000. On January 1, 1921, it was only about 29,000 miles. The number of locomotives in good condition on January 1, 1917, was 17,012, of which 36 were new. On January 1, 1921, the number was 2,921, of which 35 were new. The percentage of unserviceable locomotives on January 1, 1917, was 16.8 per cent. On January 1, 1921, it was 642 per cent.

Gasoline Motor Cars with Four-Wheel Drive

For Passenger, Freight and Light Switching; Increased Tractive Effort by Using All Wheels as Drivers

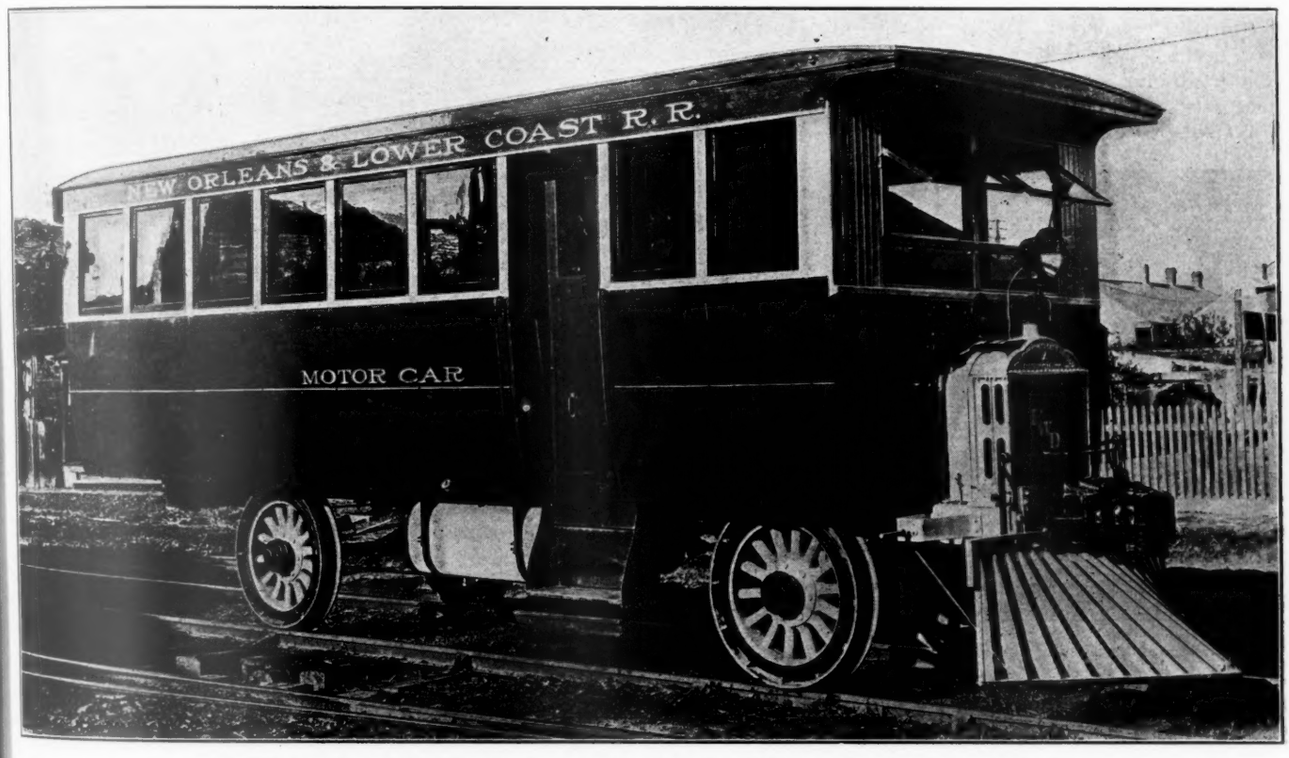
INCLUDED among the rail motor cars now in service are a number manufactured by the Four-Wheel Drive Auto Company of Clintonville, Wis. As the driving power on these cars is applied to all four wheels they have a number of advantages over cars which are driven by only one pair of wheels. Making every wheel a driving wheel and equally distributing the load over the wheels gives the car the greatest possible adhesion and permits the use of high tractive effort. This is important on roads which have numerous steep grades or are located in sections where winter weather is severe and the rails often are covered with snow and ice. In actual operation the cars have travelled over rails covered with snow to a depth of approximately one foot and in places drifted to a depth of two feet. This was done with little difficulty and without falling behind the regular schedule.

Another advantage gained through the application of power to each of the four wheels is that it eliminates the necessity of a pony truck. When rounding a curve, the differentials in the front and rear axles take care of the difference in speeds of the wheels on the inside and outside tracks and do away with the rail climbing action which has given trouble on rear driven rail equipment. At Clintonville, where numerous demonstrations in freight and passenger service have been given, there is a 16 deg. curve at one place in the track. Train operators are warned not to exceed a speed of 15 m.p.h. on this curve, yet during these demonstrations the motor cars have rounded it with ease at a speed of 23 m.p.h.

The increased available adhesion resulting from the four-wheel drive principle peculiarly adapts this type of car to use with trailers or for light hauling and switching. The manufacturer, anticipating its use for such purposes, has applied standard M. C. B. couplers on the front and rear of the car. This enables owners to attach trailers and increase the carrying capacity to meet traffic demands.

Details of Design

The standard rail motor car chassis weighs 8,400 lb. and has a 13-ft. wheelbase. The frame is 16 ft. 8 in. long and 3 ft. wide. The wheels are 36 in. diameter with rolled steel rims of M. C. B. contour. Both axles are of the rigid type, full floating. The engine has four cylinders, each 5.1 in. diameter by 5.5 in. stroke, and a power rating of 42 hp., S. A. E. rules, but actually develops 68 hp. on a brake test. The transmission provides for three speeds. There is a choice of five gear ratios ranging between 5 to 1 and 12.05 to 1, which are suitable for speeds in high of 35, 30, 25, 20 or 14 m. p. h. With a gear ratio of 5 to 1 the maximum drawbar pull is 1,968 lb. at 8.7 m.p.h. and 492 lb. at 35 m.p.h. while with a gear ratio of 12.05 to 1 the drawbar pull is 4,755 lb. at 3.5 m.p.h. and 1,189 lb. at 14 m.p.h.



Four-Wheel Drive Rail Car Used on a Sixty-Mile Run Between New Orleans and Buras

The car is equipped with a high-speed reverse gear which enables it to travel at the same speed in reverse as it does forward. This reverse mechanism is composed of a nest of bevel gears on the order of the conventional bevel gear differential, only much larger and of superior design and construction.

There is a service foot brake and an emergency hand brake, both of the external band type. In addition, Westinghouse air brakes can be applied if desired. Sanders are located at both ends.

An outstanding feature of the FWD design is the readi-

ness and cheapness with which it can be converted from a highway truck to an efficient car for railway service. This fact is borne out by the continual increase in the number operated by the government at various arsenals and proving grounds throughout the country. There is now a total of 28 FWD cars in government service operating on rails, all of which were formerly used on highways and were converted at only the expense necessary to change from rubber tires to flanged steel rims, mount standard M. C. B. couplers front and rear, and install a high-speed reverse gear and a sanding device. Where cars are to be used for passenger service the expense of conversion must include body equipment and is, of course, somewhat greater.

Cars Now in Service

The first truck of this type put into operation on rails was a standard three-ton truck converted by the Northwestern Pacific at San Francisco, Cal., into a car suitable for light switching. A tunnel was being constructed and it was found that a steam locomotive filled the tunnel with smoke and made it impossible for the men to see or breathe after the engine had been inside. After investigation, the FWD truck was decided upon and with little expense one of them was converted into a car which filled the requirements so well that it is still being operated in light switching service.

At New Orleans, La., an FWD rail passenger car seating

Interior of Passenger Car on New Orleans & Lower Coast

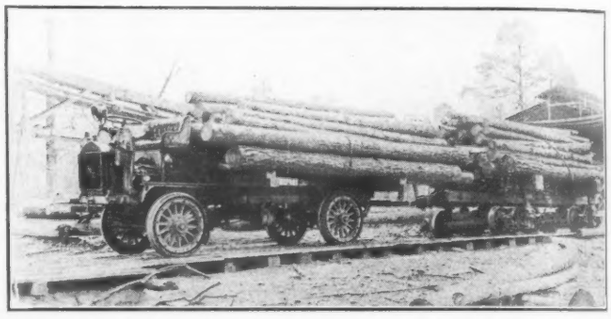
32 persons, operates on a 60-mile run between that city and Buras over the New Orleans & Lower Coast. This car makes one round trip, or a total of 120 miles per day. Latest reports show that the car, during a period of 13 months, operated at an average cost of 15 cents per mile as compared to 90 cents per mile with a steam train. These figures include operator's wages, fuel, lubrication, supplies, maintenance and insurance but do not include anything for depreciation. The motor car averaged 7½ miles per gallon of gasoline. This short line formerly operated a steam train at a loss and was obliged to discontinue service during the war. After the war it purchased a gasoline rail car and resumed operations. It was then found that not only was this car cheaper to operate but, with its weight of 6¼ tons, the depreciation of the track was much less than with the 25-ton locomotive hauling one or two 15-ton coaches.

The New Orleans & Lower Coast Railroad has, with this rail car, operated at a comfortable profit and has since the inauguration of this service enjoyed such a substantial increase in patronage that it has become necessary to increase the capacity by the purchase of a trailer coach, which will seat 40 passengers. This installation is a good illustration of what the rail car can accomplish for short line railroads and on short runs on main line tracks.

The Oil Fields Short Line, which operates from Dilworth, Okla., in the oil fields to Clifford, where it connects with the St. Louis & San Francisco, is at present installing an FWD rail car. This line is only about six miles in length and the traffic is too light to warrant the operation of a steam train. This is typical of numerous short lines throughout the country, which might operate more successfully with a light rail car than with a heavy steam train.

The Ashley Lumber Company of Hamburg, Ark., uses one of these cars for hauling logs from the woods to their mill. The car operates satisfactorily with trailers and gives a cheap and efficient service.

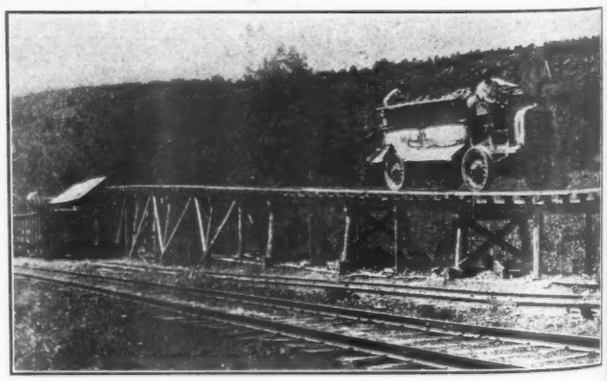
At Rockland, Mich., the Michigan Copper Mining Company operates a rail car which is equipped with a steel side dump body and is used for hauling ore from the mine to



The Ashley Lumber Company Employs a Motor Car to Haul Logs from Woods to Mill

railroad cars, a distance of about one mile. In 1919 when the mine was operating at full capacity this car operated continuously and hauled on an average of 219 tons of ore per day.

The Cripple Creek Consolidated Gold Mining & Milling Company of Cripple Creek, Colo., is operating a motor car on rails between their mines and the city of Cripple Creek. This car was formerly a standard three-ton truck used for road service, but was converted into a rail car and equipped with a passenger body which has a seating capacity of ap-



A Rail Motor Car with Dump Body Hauls Copper Ore from Mine to Main Line Connection

proximately 30 persons. It is used for hauling miners to and from the mines.

Including those operated by the government, there are now over 60 four-wheel drive rail motor cars in freight and passenger service in the United States and foreign countries.

The Province of Alberta announces that 93 miles of new railway was constructed in the province last year, bringing the total mileage up to 4,789, as compared with 1,782 in 1910, and 1,060 in 1905.

The Use of Treated Timber in Car Construction

Wood Preservers' Association Discusses Advantages of Treated Sills and Decking for Stock Cars

THE American Wood-Preservers' Association held its eighteenth annual convention at the Hotel Sherman, Chicago, on January 24-26, inclusive. This organization of men interested in the preparation and use of treated timber includes a large proportion of railway officers.

A number of the reports dealt with tie treatment and the economical benefits obtained, the use of treated marine piling to resist borers, the operation and equipment of treating plants,—including machinery and material handling devices and specifications for different kinds of creosoting oils. One of the many interesting phases of timber treatment taken up was its application to wood used in car construction.

Report of Committee on Treated Timber

The Committee on Car Lumber presented a report on the treatment of timbers used in cars and submitted recommendations on practice applicable to this particular field for the treatment of timber. An abstract of the report follows:

Since decay is responsible for more repairs to wooden cars than any other single factor it follows that a way must be found to prevent decay without retarding the work of shop forces engaged in repairing the cars. The pressure treatment is superior to other known methods of preserving wood and creosote is the best agency by which its physical life may be extended. Zinc chloride and sodium fluoride are also proven wood preservatives of high rank, but to be of any material value they must be applied under pressure, while the application of creosote by means other than pressure will unquestionably add to the life of the timber so treated.

The committee has studied every conceivable method of treating car timbers by the pressure process after they have been framed, and has found them impracticable. In most cases treating plants are located many miles from the car shops, meaning that after the timbers have been framed they must be loaded on cars and sent to the plant for treatment.

There is also the usual objection to the use of creosoted timbers that is always met with on account of refusal of labor, especially the semi-skilled labor, usually employed around car shops, to handle these timbers after they have been treated. However, this feature could be overcome by the use of zinc chloride or sodium fluoride, which are not offensive to handle, and if it were practical to apply either preservative without pressure our problems would be nearer solution.

This committee earnestly desires to see some definite step taken toward preserving car lumber and recommends the very simple method of giving all points of contact a brush treatment, using two brush coats of hot creosote. This should also apply to roofing and in the case of open and stock cars to the decking, posts and entire interior of the car.

This treatment should be applied to all points of contact regardless of whether the timber is green or dry, or whether it is white oak, red oak, pine, fir, or any other species. The best results will be obtained if the timber is dry, but it is not always dry when put in a car and we must face the conditions as they actually exist. It is certainly better to paint creosote on a green piece of timber than to put none on it at all, and this principle if accepted, must be general and cover all lumber used in freight car construction and maintenance.

Results Obtained on the Burlington

Supplemental to the above report, Forrest S. Shinn, supervisor of plant, Chicago, Burlington & Quincy at Galesburg, Ill., presented a statement of the progress in preserving car timbers on that railroad. An abstract of Mr. Shinn's statement follows:

The Burlington has treated 1,297,188 ft. b. m. of car sills and 1,815,804 ft. b. m. of car decking. These were treated with the straight creosote process as follows:

Year	Sills, Board feet	Decking, Board feet
1911	104,700	115,728
1912	409,764	1,087,116
1913	339,720	153,012
1914	223,500	89,892
1915	53,736	56,688
1916	166,068	176,796
1917	.....	79,888
1918	.....	56,688
Total	1,297,188	1,815,804

We are not in a position as yet to know just what results will be obtained from this treatment, as none of the lumber has been taken out for any cause except on account of being broken; however, in view of the fact that we are taking out yearly a large amount of untreated flooring on account of rot we feel that the money spent for treatment has brought good returns. We have not made any tests on this material, comparing the strength of the treated lumber with the untreated, but from close observation have come to the conclusion that treatment very materially increases the hardness and makes it much more resistant to wear. We find that many untreated planks in cars built in 1911 and 1912 have been worn so thin that they had to be replaced.

In November, 1921, two treated planks were removed for inspection from the end of C. B. & Q. car 67391, built in May, 1912, with treated sills and flooring; two treated gangway planks from C. B. & Q. car 67190, built in February, 1912, with treated sills and flooring; and two treated gangway planks from C. B. & Q. car 68729, built in September, 1915, with treated sills and flooring. There was no sign of decay on either the sills or flooring. The planks were slightly worn but were perfectly sound and, from all appearances, were good for as many years more life as they had already given. On the same day two untreated gangway planks were also removed from C. B. & Q. car 67261. This car was built in March, 1912, with treated sills and flooring, with the exception of the gangway plank which was not treated. These two untreated planks were warped, shattered on the ends, and worn down to less than half the original thickness.

In the last month I have inspected 200 stock cars built in 1914 or earlier, 100 of which were built with treated sills and decking and 100 built with untreated sills and decking. The treated decking is in as good condition as when first laid down, showing no signs of decay, warp, or check, while the untreated decking is badly warped or buckled and all of it is more or less checked, and in a large percentage the ends are badly shattered.

We feel that some time in the future we are going to be able to prove conclusively that the treatment of sills is justifiable. I have seen many decayed sills in cars built 1900 to 1906 and I am sure that everyone will agree with me that a well treated car sill will never show any signs of decay unless it was decayed before being treated.

In addition to the treatment of sills and decking for stock cars we treated, with the Burnettizing process, sub-flooring for one dining car that was placed in service May, 1921, and one that was placed in service June, 1921. We also treated sub-flooring with the Card process (zinc chloride and coal tar creosote) for two dining cars that will be placed in service soon. We have found that sub-flooring in the kitchens of these cars rots quickly and are sure that we can overcome this by preservative treatment.

Vacuum Brake Tests on English Freight Trains

Results of Great Northern Trials Reported by Sir Henry Fowler and H. N. Gresley Before Institution of Civil Engineers

THE use of vacuum brakes both in England and in the United States is almost as old as that of air brakes. In this country the vacuum brake many years ago practically passed out of existence except for a few industrial locomotives. In England the vacuum brake has been continued in service and is even now extensively employed, and the same is also true to a large extent of some other European countries, as well as India, Australia, Africa and South America.

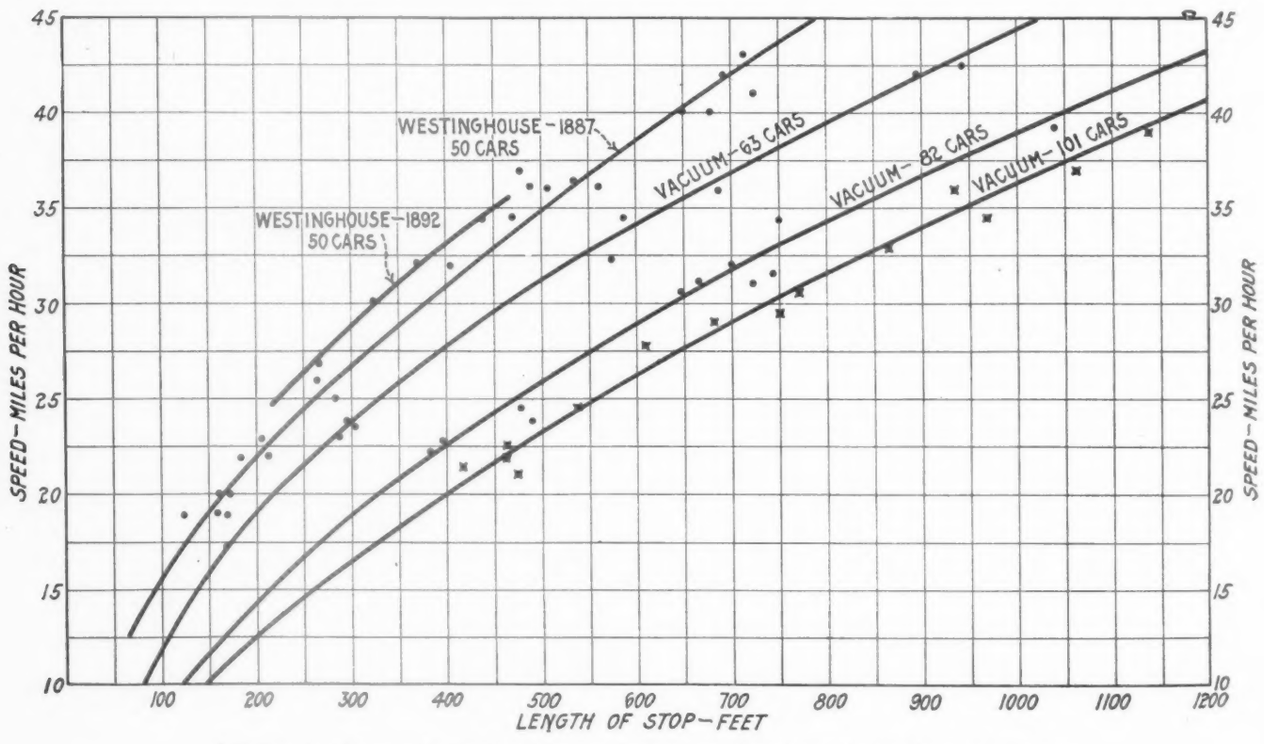
Evolution of the Vacuum Brake

In its evolution during the last 50 years the vacuum brake passed through changes paralleling those which took place in the air brake. At first, a plain vacuum brake met the requirements. The brake pipe was normally open to the atmosphere and an ejector was used to create a vacuum in the brake pipe and diaphragm or cylinder on the various cars when it was desired to apply the brakes, the vacuum being destroyed to release the brakes. This system was long ago superseded by the automatic vacuum brake in which a vacuum is constantly maintained in the brake pipe and in the enlarged chamber or attached reservoir above the brake piston, the vacuum being partially or fully destroyed to apply the brakes and again restored to release the brakes. A combined ejector and brake valve is commonly employed to create the vacuum and to control the admission of air to the brake pipe. This ejector has two nozzles, a large one for creating the initial vacuum and for releasing the brakes and a small nozzle for maintaining the vacuum after the brakes have been released.

Thus far the application of power brakes to freight equipment in England has been quite limited. The steadily increasing length and weight of passenger trains as well as a growing demand for power brakes on freight trains has, however, led to the development of accelerating or rapid action valves for the quicker application of the brakes on longer trains. These, however, have not yet been extensively applied.

Advantages and Disadvantages of the Vacuum Brake

To an American who has been accustomed to the air brake only, or who perhaps recalls the vacuum brake as largely an old experimental device, it is somewhat surprising to learn that the vacuum brake is even more common in England than the air brake. This raises the question as to why the vacuum brake has been able to retain its position and what advantages it possesses. The outstanding reasons appear to be: the simplicity of the mechanism and its low expense of maintenance; the perfect control of braking due to the fact that the braking pressure can be increased or decreased at will without releasing the brakes; and the smoothness of the stops, this last feature being due partly to the use of lower rates of retardation than are demanded by American railroads. There is a distinct disadvantage in the relatively large size of the brake cylinders which is a result of the low cylinder pressure of less than 10 lb. per sq. in. This is only one-sixth of the pressure used in air brake cylinders.



Comparative Stops with English Vacuum Brakes and American Westinghouse Air Brakes

Vacuum Brake Tests on the Great Northern

With a view to ascertaining the suitability of the vacuum brake for long freight trains, a series of trials was carried out during the summer of 1919 on the Great Northern Rail-

way. These tests were under the supervision of Sir Henry Fowler and H. N. Gresley who presented a paper before the Institution of Civil Engineers on January 10, 1922, giving the results of the runs. The facts given herewith are taken from this paper.

The main difference between braking freight trains and passenger trains are briefly as follows.—(*a*) The greater length of freight trains. (*b*) The necessity of running loaded and empty cars together in freight trains. (*c*) Even if screw couplings are used, the need of quickly coupling and uncoupling when switching will probably result in the couplings being screwed up less tightly than in passenger trains. This tendency to couple loosely enhances the need for a smooth and uniform action of the brake throughout the train.

For these tests the following conditions were laid down as a standard of satisfactory performances:

That trains of 100 cars, close coupled, must be stopped:

(1) By emergency applications without shock and without any risk of parting the train.

(2) By service applications without shock or risk of parting, and in such a manner that the train could be restarted immediately after coming to rest.

(3) That the speed of the train could be reduced as required.

The tests were carried out on the Great Northern railway between Petersborough and Firsby, this portion of the line being practically free from grades and curves.

Trains and Equipment

The locomotive was of 2-6-0 type. The weight of the locomotive in working order and the tender two thirds loaded with coal and water was 213,920 lb. All wheels were braked with the exception of those of the front truck. The ejector was a Gresham and Craven combined 20 mm. and a 25 mm. Dreadnaught.

The train consisted of Great Northern railway eight-ton covered vans or box cars, having an average light weight of 16,150 lb. and fitted with the G.N.R. standard vacuum brake, with the Westinghouse Brake Company's accelerators and reducing nipples. In addition to these the train included three Midland railway six-wheeled cars carrying the necessary recording instruments. One of these was placed at the front of the train, one in the middle, and one at the rear.

All the cars were unloaded and provided with screw couplings. The brakes were tested for leakage before the trials, and the travel of the brake pistons adjusted as required. The instruments comprised speed recorders and duplex vacuum recorders. The latter instruments (one of which was placed in the front, middle and rear vans) recorded the pressure in the train pipe and brake cylinder reservoir.

The average retarding force is the basis usually adopted for comparing brake stops. This force is convenient to express as a percentage of the weight of the train, and in the calculations, the weight of the train is taken as the gross weight of the train increased by the equivalent rotary inertia percentage, which was found from calculation to vary from 10.4 to 10.7 per cent of the weight of the train, being about 7.3 per cent for the locomotive and tender and 11.1 per cent for the cars. The forces concerned, inclusive of brake power, friction and gravity, are assumed to be acting uniformly throughout the stop.

The standard vacuum carried in the brake pipe was 20 in. and the average effective vacuum in the car brake cylinders with the brakes fully applied was 17 in. or 8.33 lb. per sq. in. The brake shoe pressure equalled 61 per cent of the weight of the locomotive and tender, 90 per cent for the cars and 86 per cent for the train complete with the locomotive.

Results on Trains of Various Lengths

The first tests were made with a 63-car train, each car being fitted with an accelerator and a standard reducing nipple between the brake pipe and the under side of the piston in the vacuum brake cylinder. The standard size of choke is 3/16 in. diameter for a 15-in. cylinder and 5/16 in. for an 18-in. cylinder. The weight of the 63 cars was 455.25 long tons or 1,019,760 lb. All emergency stops made under these conditions were satisfactory. It was found necessary, in making speed reductions or service stops, to apply the brake gradually, otherwise the accelerators operated, and unless the speed was high, say over 30 miles per hour, the train came to a stand before the brakes could be released.

The 80-car train was made up by attaching nine cars at the front of the previous 63-car train and eight cars at the rear; these cars had no accelerators or reducing nipples. Five emergency stops were made from speeds ranging between 22 and 42 miles per hour, but the shocks were so severe that in one case the train parted. The front nine cars were switched out and another emergency stop made, but the shock was so bad that the train again parted. The records of these stops were spoilt on account of the effect of the shocks on the instruments, and it was decided to abandon further trials with trains not completely fitted with accelerators.

The next tests were made with an 82-car train, fitted with accelerators and standard reducing nipples throughout. The total weight of the cars was 587.5 long tons or 1,316,000 lb. At speeds above 40 miles per hour the stops were fairly smooth, but between 30 and 40 miles per hour there was a rough jerk just before stopping, and for stops from 20 to 30 miles per hour the jerk was very severe just before coming to rest. The stopping distances of this train were almost identical with that of the 63-car train. Emergency stops were then tried with the working vacuum reduced to 16 in. These were fairly smooth except at the lower speeds, but the stopping distance was increased by about 20 per cent.

The next change was to reduce the size of the chokes in the nipples to 7/64 in. diameter for a 15-in. cylinder and to 1/8 in. for an 18-in. cylinder. The train consisted of the same 82 cars fitted with accelerators. The effect of the reduced nipples was to make the stops at all speeds quite satisfactory as regards being smooth, but increased the stopping distance by about 25 per cent.

Following these tests the length of the train was increased to 101 cars, the total weight of the cars being 719.5 long tons or 1,611,680 lb. All cars were fitted with accelerators as well as specially reduced nipples of the same size as those used on the preceding 82-car train. The emergency stops were quite satisfactory as regards being smooth, but compared with the standard of comparison—63-car train—the stopping distance was increased by about 35 per cent. Emergency stops were also made working with a 16-in. vacuum. In this case the stops were very smooth, but the stopping distance compared with the standard was increased approximately by 50 per cent.

General Conclusions

(1) The trials demonstrate that it is practicable with the vacuum brake to work long trains of up to 100 cars, provided that suitable accelerators and reducing nipples are used.

(2) Emergency stops can be made without shock with trains consisting of up to 100 cars.

(3) Service stops and speed reductions can be made and the train restarted promptly, provided that when running at speeds less than 30 miles per hour air is admitted slowly so as not to operate the accelerators. This necessitates the braking being spread over some distance, but allows time to have the brakes partly released when the desired reduced speed is reached, or just before stopping, and thereby en-

ables the train to get under way again almost immediately.

(4) It must be recognized that the provision of reducing nipples results in retarding the action of the brake and increasing the length of stops.

(5) In these trials the smoothest stops were obtained with the comparatively low working vacuum of 16 in. It is also easier to create and maintain this degree of vacuum than the usual 20 in., but the stopping distance in the case of emergency stops, is of course increased.

Comparison with American Air Brake Tests

In connection with the results in these English vacuum brake tests on the Great Northern as outlined in the above paper, it is of interest to compare the length of the stops with those obtained in American brake tests. Soon after the completion of the famous Burlington brake tests in 1887, the Westinghouse Air Brake Company perfected its quick-action triple valve. In order to demonstrate the operation of the device, a train of 50 Pennsylvania Railroad box cars was equipped and exhibition stops were made on a number of railroads in a dozen different cities. The cars were of 60,000 lb. capacity and 38 ft. 4 in. long. The light weight was 30,577 lb. each or a total of 1,528,850 lb. for the 50 cars, exclusive of the locomotive and tender. Including the locomotive and tender the weight was about 2,000,000 lb. The 50 American cars used at that time thus weighed about the same as ninety-five of the English eight-ton cars used in the vacuum brake tests described above.

As a convenient method of showing the results of these tests, the length of the stops has been plotted and a curve drawn for the general average.

In 1892 a series of brake tests was made on the New York Central at Karners in order to compare the Westinghouse and New York air brake systems. These tests were also made on 50-car trains of box cars of 60,000 lb. capacity. The average weight of the cars was 31,960 lb., making the total weight of the 50 cars 1,598,000 lb. The length of the train was 1,940 ft. The braking power on the cars was 70 per cent, calculated on 60 lb. brake cylinder pressure, the brake pipe pressure carried being 70 lb.

Stops were made at speeds ranging from 25 to 35 miles per hour. The average results have been plotted and are shown on the accompanying diagram.

On the same diagram curves have been drawn for the stops made with the English trains. One of the curves shows the stops for the 63-car train with accelerators and standard reducing nipples. Another curve shows the stops for the 82-car train equipped with accelerators and special reducing nipples while the remaining curve shows the results for the 101-car train with the same size special reducing nipples. On all the trains the standard working vacuum was 20 in. Stops have not been plotted for the runs made with a 16 in. working vacuum.

A striking feature brought out in these curves is the fact that air brake stops made in this country 30 to 35 years ago are noticeably shorter than those made in the recent English tests with trains equipped with the vacuum brake. For example, from speeds of 30 miles per hour, the stops for the Westinghouse train of 1892 was 325 ft.; for the Westinghouse train of 1887, 380 ft.; for the vacuum brake train of 63 cars, 465 ft.; for the vacuum train of 82 cars, 645 ft., and for the vacuum train of 101 cars, 745 ft.

In view of the results it would appear that the vacuum brake does not have the retarding effect of the air brake as used in America. It is unfortunate that conditions did not permit of equipping the test train with the type of accelerator valves made by the Vacuum Brake Company although it is probable that the results of the tests would not have been materially different. Had this been done and the tests continued the information obtained would have been an even more valuable addition to the knowledge of braking.

Care of Journal Boxes*

By J. M. O'Connor
General Lubricating Instructor, New York Central

AFTER giving this matter our undivided attention for several years past, we have concluded that the proper method of packing journal boxes is as follows: Back rolls shall be prepared in advance in the oilroom and stored there until required for service. The preparation of the rolls consists of shaping the dry waste, dipping in oil and draining until moderately dry. Place roll in mouth of journal box, work it back under the journal to the extreme back of the box, leaving it in such a position that it does not extend above the center line of the journal. The rest of the packing should then be placed under the journal firmly so as to prevent settling away. This is best accomplished by placing the packing across the full width of the mouth of the journal box and allowing the strands to hang down outside, always adding more packing before placing the hanging strands inside the box. This has the effect of binding all the packing in one mass. The packing must not extend above the journal center line or beyond the inside face of the collar.

Considerable controversy has arisen over the elimination of the so-called front waste plug, and in this connection, insofar as our system is concerned, it is felt that this departure greatly assists the inspector in examining the contained parts of the journal box, particularly the journal, as under this method the end of the journal shows plainly when the bearing is being properly lubricated. When the bearing is not being properly lubricated, the center of the end of journal appears dry, whereas where the front waste plug is used, the end of the journal shows oil at all times. When the packing is applied as outlined there is practically no danger of it working from underneath the journal at the collar. The binding of all the packing as one mass also prevents its working up on the sides of the journal.

The application of packing can only be accomplished by the use of a standard packing iron, which is 26 in. in length. The spoon end of this iron has a curve 3 in. in depth measured horizontally from the handle lug to the fork end.

With reference to the care of packing in journal boxes, the most important part of the work for successful lubrication is intelligent attention to its condition which briefly consists of loosening up the packing to avoid the formation of a hardened and glazed surface from too long contact with the journal. This work consists of first loosening the section of the packing by pulling it forward from the sides and working it back under the journal at the center. Second, if new packing is needed, it should be worked back under the journal from the center, thus raising the portion on the sides—care being taken that it is not lifted above the center line of the journal on either side. This work also can only be handled by the use of the packing iron.

When the care of packing in journal boxes—and this applies particularly to cars in train yards—is handled as above outlined, the oil is automatically forced from the bottom of the box to the surface of the waste, particularly in boxes where all cotton or a mixture of cotton and wool is used.

While we know that the serviceable condition and proper application of packing is not responsible for all journal failures, it has been our experience that a percentage of the hot boxes may be attributed to this feature.

Now that the M.C.B. rules make the car owner responsible for the packing of journal boxes every nine months, when cars are on repair tracks, we should have a uniform method of handling and applying this material, and in talking this matter over with some of the best car men they fully agree that this is a step in the right direction.

*Abstract of a paper presented before the Niagara Frontier Car Men's Association, Buffalo, N. Y.

Practical Education in the Car Department*

Systematic Instruction and Examination of Inspectors and Foremen and Annual Staff Conventions

By C. G. Juneau
Master Car Builder, Chicago, Milwaukee & St. Paul

THE experience of ages has been used to build up and advance most of our methods of transportation, but in railroading we have only the wisdom of a hundred years to help solve our problems. And as the United States contains some 60 per cent of the railroad mileage of the world and the remaining 40 per cent is scattered over the face of the earth, we cannot even turn for help to others but must confine our studies to an analysis of our own experiences in the endeavor to solve our difficulties.

Examination of the industry of railroading reveals, first, that it is immense. Excluding agriculture, it is the largest single industry in the country, and it approaches in size a majority of the other industries combined. Its very immensity means to it many problems. Second, it is very complex in its make-up, including, as it does, large and varied forms of activities. Wide experience is a first necessity to a successful railroad man. Third, it is variable, ever fluctuating in quantity and changing in character. The problem of how to handle a certain quantity of coal today will be replaced tomorrow by a deeper problem, because of the changing of the chief commodity to be moved to wheat, lumber, or oil. There is nothing tangible to guide railroads; and as business conditions change much more rapidly than it is possible to alter existing equipment or provide new equipment, only by careful study of all forms of industrial and agricultural conditions, politics, money markets, and general world conditions, can an intelligent forecast of demands upon the railroads be arrived at.

The fact that the undertaking is so immense at once suggests that railroad employees should be drawn from particular schools or universities wherein they would be specially trained for one or another of the phases of railroad work. No educational institution can produce a railroad man for the reason that railroading is complex and fluctuating. His education must accompany his experience, and must change to conform to fluctuations in railroad conditions.

Lacking centuries of experience on which to base their judgment, unable to use the experience of other countries, and unable to turn to educational institutions to provide a trained personnel, the railroads' one chance of resurrection seems to lie in the education of their own employees along the lines of their employment.

Railroad education might be divided into three phases, viz., (1) education of the men; (2) education of their officials, and (3) education of the public. I am going to deal mainly with the first subject and confine my remarks to our own experiences in the mechanical department of the railroad I serve.

Systematic Education of Foremen and Inspectors

As a prelude to our educational campaign, it was laid down that all officers in the mechanical department should endeavor to educate those responsible to them to help in making railroad service a vital response of human effort and energy. It was realized that the first milepost could not be successfully and safely approached unless those interested undertook their work seriously, and this could not be brought about until those in charge had created an atmosphere of respect and established the fact that there was need for each employee's best effort.

The multiplicity of instructions and the rapidity with which they were issued during government control made compliance with them almost a human impossibility. Conflict, doubt and confusion existed. Our then master car builder drew up and issued a booklet laying down guiding rules for every phase of work in the car department. This was issued to all supervisory forces, and its effect was electrical. Summed up in the terms of the carman, "it put the car department on the map." The principal parts of this booklet were published in the Railway Mechanical Engineer, commencing in January, 1920. This move may be termed the real beginning of our educational system in the mechanical department. At the present time, a book covering the maintenance of and repairs to locomotives, and instituting standard practices even to the finest detail, is in process of completion. In the meantime the information is utilized by being issued piece by piece in the form of circular letters.

Following the issuance of the first booklet, a concerted move was made to have every foreman or group of foremen provided with a Car Builders' Dictionary and to supplement this later with other books. Those engaged in special undertakings were induced to obtain the most authoritative publications dealing with their particular work, and many of our car department supervisors became connected with institutions and organizations which conducted discussions and issued current literature on terse subjects.

Monthly educational bulletins have been issued which deal systematically with the various phases of the car department work. One series of articles covers air brake work, another safety appliances, etc. The bulletins are furnished in sufficient quantities to make the information available to every employee in the department, no matter where located. Questions arising in connection with the articles are taken up by the men direct with whoever is conducting the publication, without passing through any official channels, and the questions and the answers both appear in the next issue of the bulletin. When necessary, the bulletins are supplemented with blueprints or sketches.

It was realized, however, that results would be derived more from successful application than from any particular virtue of the scheme itself. We therefore arranged for every inspector—freight and passenger—to be examined by our general safety appliance inspector, and later all foremen were similarly questioned. When this questioning was completed, a regular monthly examination system was inaugurated. This is conducted by sending to the district general car foremen 20 questions, based on information previously published in the educational bulletins, which on a given day are distributed to inspectors and foremen. Below each question, space is provided for the answer. When filled in the papers are returned and marked; five marks per question are allowed. The results are systematically recorded in my office and bulletined locally.

As a result of this system we have effected an improvement beyond our most sanguine expectations. The first report on our educational campaign stated that the then existing opinion that bad safety appliance conditions on our cars and locomotives was due to negligence was not correct; it was

* Abstract of a paper read before the Western Railway Club, Chicago, on January 16, 1922.

due to ignorance. It went on to say that not more than ten per cent of the inspectors on the system could pass an 85 per cent examination, and not 25 per cent could pass a 50 per cent test. That report was made less than two years ago, but today the number not regularly obtaining 90 per cent is negligible. Of course there has been quite a little transferring of men to other work, and in some instances inspectors have had to be taken out of service. But our inspectors today—the men we regard as of primary importance to the movement of our equipment—wear an air of confidence born of knowledge. Our derailments and accidents have decreased, and our percentage of on-time trains has risen to a very pleasing degree.

The examinations so far have been confined to safety appliances and matters connected directly and indirectly therewith. Extension to air brakes is being made, and we propose gradually to include questions concerning wheels, axles, general repairs, etc. Now no carman is appointed an inspector unless he can pass the necessary practical examination. Men desirous of promotion are voluntarily taking the monthly examinations, and we have at present a considerable number of men fast qualifying for positions of responsibility. The enthusiasm alone displayed by the men has been full reward for the effort necessary to inaugurate and sustain the campaign, but I feel that the big harvest is yet to be reaped.

Annual Department Staff Meetings

It was realized that as a group railroad employees attained a tremendous measure of experience, due to the large scope of the work, but that failure resulted from lack of opportunity for exchanging ideas. Accordingly, it was arranged to hold annual staff meetings of the car department and the locomotive department at Milwaukee. Later we inaugurated conventions of the blacksmiths, traveling engineers, and others interested in a particular phase of railroad work. At these staff meetings and conventions, prepared papers are read and discussed. The keen interest of the management in the meetings has been evidenced by the attendance of the president, vice-president, general manager, general superintendent of motive power and other officers. Such meetings as these wherein matters are discussed without restraint are most valuable educational schools. Foremen or master mechanics opposed to a scheme proposed by the management will leave such meetings enthusiasts for the scheme by virtue of knowledge of the other man's viewpoint; or, on the other hand, modification and even withdrawal of schemes may result from cold facts produced by unrestrained discussion.

At these staff meetings supervisors are educated as to how to deal with their men, to lay out their work, to handle their material. The papers and the discussions are printed and circulated, so that every foreman on the system may obtain the fullest possible benefit from the meetings. The papers are not contributed wholly by men within the mechanical department, but also by those in other departments, and even by persons entirely outside of the railroad field. Our aim is to secure as authentic articles as possible, to spread their contents by means of discussion, and then to make them available as guides for the following year's work.

Special instructions prepared and issued for various classes of service include, in addition to safety appliances and air brakes, already mentioned, valve motion for locomotives, electricity, and the federal locomotive inspection law. Monthly reports covering all phases of the department's operations are issued to principal supervisors and, in condensed form, to every foreman on the system.

Education of Operating Officers

Because the mechanical side of railroading has never ceased to advance, there arises the necessity of educating those we serve in the operating department to the viewpoint resulting from our experience and experiments. This task is simplified somewhat where officials have served in the ranks, or made more difficult where they have not. It is not an easy matter to impart one's knowledge to another, and the added handicap of lack of time and opportunity often makes it a difficult problem. The need of having those administrating a department made aware of all that is involved, however, stands out very clearly in my mind. The means we endeavor to employ to attain the desired result is discussion of each problem by the men on the spot. This admittedly does not entirely serve the purpose, and greater education in this direction is much to be desired.

Education of the Public

Although the railroads are servants of the public, it is astonishing what colossal ignorance exists in regard to even the simplest phases of their operation. This alone is a severe handicap to railroads in their present dilemma; but when public opinion is fed by contributions to a vicious press by authors often ignorant of anything beyond the most elementary railroad matters, they are even further harassed. I do not refer to the press as a whole, but to a certain section of it which allows its remarks on railroad problems to take the form of destructive criticism. Such articles are not productive of any good, but do the railroads much damage. If the section of the press referred to is attempting to harm the railroads, its attitude is a great success. If it is trying to better conditions for the public, it is a drastic failure.

Partially as a result of the attitude referred to, we occupy the very unpleasant position of having a portion of the public believe that the railroads are nothing but a network of intrigue—rotten in morals and with only sordid aims in view. To those who have devoted the best part of their lives to the work, not because they received adequate monetary or other reward, but because the word "service" meant to them what the colors mean to a regiment in battle, this is indeed their cup of bitterness. It is time for action. Let us concert our efforts to have the public know that the railroad man is not a rotter, not an ignoramus, but their efficient most loyal servant, and a worthy citizen of this great republic.

Exports of Apples from Halifax, N. S., this season have amounted to 613,886 barrels, 5,635 boxes and 3,739 half barrels. These apples have gone to Liverpool, London, Manchester, Glasgow, Hull, Avonmouth, Cardiff, Newfoundland, West Indies, New York and Boston.

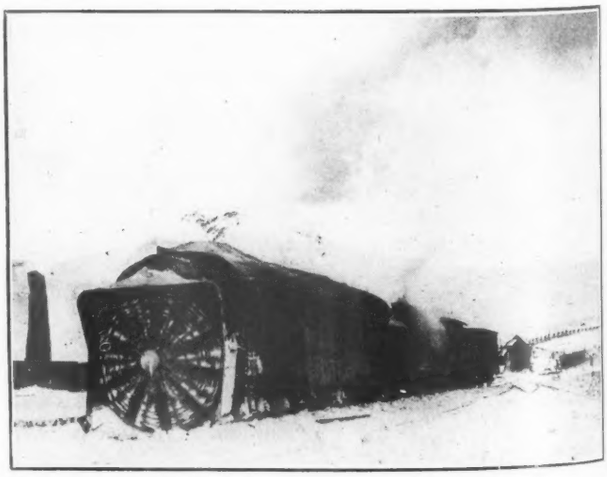
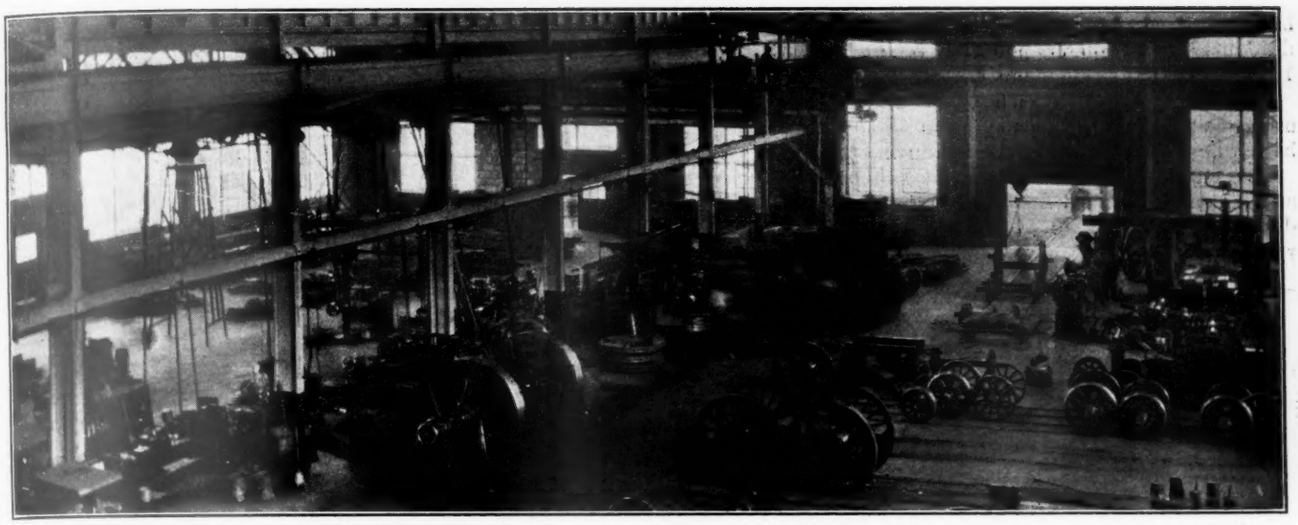


Photo by Kadel & Herbert

Fighting the Snow in Norway



What Shop Equipment Means To a Railroad*

Central Railway Club Discusses Relation of Maintenance and Repair Facilities to Equipment Owned

By V. Z. Caracristi
Consulting Engineer, New York

RAILROAD motive power departments are continually being pressed for reasons why they demand from the higher officials appropriations to cover machine tools and shop facilities, and the repetition of statements that these facilities are required to take care of current work is usually countered by explaining that the need for such facilities will have disappeared by the time the equipment and facilities can be received and installed. Operating revenue, having so many mouths to feed, must be largely conserved for purposes which cannot be deferred, and in the face of the large demands, the weak voice of the motive power department is drowned by the clamor of what at the moment appear to be more important demands.

Starting out on the basis that there can be no question as to the necessity for providing facilities of some nature to take care of each unit of power or equipment acquired, I am endeavoring to crystallize the tangible requirements and to point out the reasons why such requirements exist. Eliminating the equally important necessity for yard and terminal facilities, I would like to offer a chart (Fig. 1) showing the expenditures which experience has led me to believe necessary to take care of the locomotives and cars coming immediately under the jurisdiction of the motive power department.

To summarize, the object of this paper is to point out briefly the reason why equipment is compelled to stand idle when it should be at its best condition to meet operating demands, as well as to endeavor to create as a basis for further discussion the actual capital requirements in terms of equipment owned or in future to be purchased.

Available Hauling Capacity Not Utilized

As a matter of interest the data (Tables 1 and 2) on actual locomotive operation are submitted, locomotives being selected for the reason that they offer a well-defined measuring stick to compare relatively what is being accomplished by them in repayment for the labor, material, and money which have gone toward their creation. This measuring stick can best be expressed by their hauling capacity. The relation between weight, hauling capacity, and cost is practically constant. A definite amount of weight is necessary for each pound of hauling capacity available, and the locomotives are themselves purchased indirectly on a weight basis.

The purchase of additional hauling capacity immediately entails an obligation on the part of the purchaser to utilize such facilities, and to secure revenue therefrom through the handling of freight or passengers.

The uniform system of accounting used by railroads, based on regulations of the Interstate Commerce Commission makes available as a whole the total tractive power and ton-miles of freight hauled.

In order to make a division line between the freight and passenger service, it is necessary to convert passenger earnings into ton-miles. In my opinion this conversion can best be made on a basis of earning capacity, for which purpose the equated ton-miles on passenger basis can be obtained by multiplying the ton-miles of freight by the total passenger revenue and dividing this figure by the total freight revenue, the underlying thought being that the decreased tonnage will be offset by the increased rate. Such figures, although perhaps of no other value, will result in a ton-mile basis which is comparative from year to year. A comparison made on this basis, using Interstate Commerce Commission statistics of Class I railroads for the years 1902 to 1919 inclusive, brings out startlingly the fact that in spite of advanced facilities in design during the 18-year period the amount of work performed by the locomotive was seriously decreased, as is evidenced by the fact that the increase in tonnage available was 233 per cent; the increase in the number of locomotives was 173 per cent, with an increase in the hauling capacity of 299 per cent. The efficiency of the 1902 locomotive being used as a basis, the railroads during the year 1917 could have

*Abstract of a paper read before the March 9, 1922, meeting of the Central Railway Club at the Hotel Iroquois, Buffalo, N. Y.

handled 56,000,000,000 more revenue ton-miles than they did; in 1918, 76,000,000,000 more revenue ton-miles, and in 1919, 139,000,000,000 more revenue ton-miles.

In other words, had each pound of tractive power been utilized at the same efficiency as in 1902 there would have been a large surplus of locomotives during these peak periods.

These analyses cover totals for the 12 months of each year, and it may be claimed that peak traffic demands during individual months produced conditions not reflected by the yearly average. However, it should be remembered that the power delays brought about by inadequacy of repair shop facilities. Power of sizes and weights out of line with shop equipment result not only in increased repair expense but what is more serious, in great delay in getting power back into service.

Adequate provisions in the way of machine tools will have a great influence on recovering, if not passing established records previously made in ton-miles per pound of tractive power available.

Capital account expenditures cannot be made to better

TABLE I—COMPARATIVE ANNUAL STATISTICS OF LOCOMOTIVE OPERATION ON CLASS I ROADS

Year	No. locomotives, total	Tractive power total pounds	Revenue ton miles	Total passenger †revenue, dollars	Freight train revenue, dollars	Equated ton ‡miles passenger	Equated ton miles, total freight and passenger
1	2	3	4	5	6	7	8
1902	37,516	768,502,779	157,289,370,000	$392,963,248	$1,207,228,000	51,109,045,250	208,398,415,250
1903	43,290	941,915,540	173,221,278,000	421,704,592	1,338,020,026	56,296,915,450	229,518,193,450
1904	46,146	1,052,307,260	174,522,089,000	444,324,991	1,379,002,000	56,196,112,658	230,718,201,658
1905	47,696	1,123,771,082	186,463,109,000	472,694,732	1,450,772,833	62,036,276,364	248,498,385,364
1906	50,954	1,260,633,673	215,877,551,000	510,032,583	1,640,386,655	67,116,330,605	282,993,881,605
1907	54,563	1,409,006,658	236,601,390,000	564,606,343	1,823,651,998	73,133,489,649	309,734,879,649
1908	56,867	1,498,793,551	*218,381,554,000	566,832,746	1,655,419,108	74,795,682,245	293,177,236,245
1909	56,468	1,503,971,444	*218,802,986,000	563,609,342	1,677,614,678	73,496,922,997	292,299,908,997
1910	58,240	1,588,894,480	*255,016,910,000	628,992,000	1,925,553,036	83,298,522,706	338,315,432,706
1911	60,162	1,681,495,905	*253,783,701,839	657,638,291	1,925,950,887	86,743,271,288	340,526,973,127
1912	61,010	1,746,964,128	*264,080,745,058	660,373,176	1,968,598,630	85,919,493,672	350,000,238,672
1913	62,211	1,847,798,393	*301,398,752,000	695,987,817	2,198,930,565	96,748,999,392	398,147,751,392
1914	61,442	1,886,549,588	*288,319,890,000	700,403,353	2,114,697,629	92,752,508,613	381,872,398,613
1915	61,882	1,970,295,300	*273,913,000,000	629,237,464	1,977,933,275	87,121,727,208	361,034,733,208
1916	60,790	1,989,132,700	*339,870,323,000	673,806,175	2,402,210,993	95,153,690,440	435,024,013,440
1916	60,990	2,024,118,700	*362,444,397,000	722,359,371	2,631,091,957	99,489,886,876	461,934,283,876
1917	61,533	2,087,949,700	*394,465,400,493	825,211,593	2,819,965,215	115,420,566,166	509,885,966,659
1918	63,531	2,223,246,296	*405,379,284,206	1,030,964,999	3,440,792,218	121,492,271,414	526,732,555,414
1919	64,983	2,301,602,581	*364,293,063,017	1,175,035,413	3,543,329,921	120,799,579,684	485,092,642,701

*Does not include returns from terminal and switching companies.
†Excluding mail, express, milk, parlor cars, switching and special train income.
‡Equated ton miles — passenger = ton miles (freight) X $\frac{\text{passenger revenue}}{\text{Freight revenue}}$

relative peaks which existed during 1902 also existed in 1919. In other words, seasonal demands will not startlingly increase without reflection in the traffic during those months of lesser traffic movement.

Lack of Repair Facilities Decreases Net Returns

The reasons for the decrease in economic returns are a little complex, but they can be roughly analyzed as follows:

(a) The increased ratio of the power available does not appear to be serious.

(b) The lack of corresponding increases in terminal facilities in the way of increased length of receiving tracks, etc., as well as lack of expenditures for increased passenger facilities, are serious.

(c) The dominating influence affecting the decrease in work performed per unit of power available lies in the lack of capital expenditures for maintenance of equipment purposes. Individual road performance and increase in tonnage per locomotive mile run has been more than offset by motive

TABLE II—SUPPLEMENTARY DATA ON CLASS I ROADS' LOCOMOTIVE OPERATION

Year	Ton miles per lb. tractive power	Ratio of passenger to freight earnings	Capacity at 1902 efficiency	Surplus capacity, ton miles	Per cent	Earnings per lb. tractive power available = 5÷6÷3
	9	10	11	12	13	14
1902	271.2	.325	208,398,415,250	.....	...	$2.08
1903	243.7	.3152	255,447,494,448	47,049,079,198	20.9	1.87
1904	219.1	.3222	285,375,728,912	54,657,527,254	23.2	1.73
1905	221.1	.3327	304,796,717,438	56,298,332,078	22.7	1.80
1906	224.5	.3109	341,883,852,117	57,889,970,712	20.5	1.78
1907	216.3	.3091	382,122,606,649	72,387,727,000	23.4	1.69
1908	195.8	.3425	406,472,811,103	113,295,574,786	38.6	1.48
1909	194.4	.3359	407,876,956,612	115,677,047,635	39.3	1.49
1910	212.8	.3266	431,108,182,976	92,792,750,270	27.4	1.61
1911	202.5	.3418	456,021,689,436	115,494,716,309	33.9	1.53
1912	200.0	.3405	475,776,671,513	125,776,432,841	35.7	1.50
1913	215.4	.321	501,022,924,381	103,875,172,989	26.0	1.56
1914	202.0	.3217	511,632,348,265	130,559,949,652	34.2	1.49
1915	183.2	.3181	534,344,085,360	173,309,352,152	48.0	1.32
1916	218.7	.280	539,450,788,240	104,426,774,800	24.0	1.54
1916	228.0	.2745	548,940,991,440	87,006,707,564	18.8	1.65
1917	244.2	.2926	566,151,958,640	56,275,991,981	11.0	1.74
1918	236.9	.2997	602,944,395,475	76,211,840,061	14.4	2.01
1919	210.7	.3316	624,194,619,967	139,101,977,266	28.6	2.05

advantage at this time in any direction by the railroads than through provisions for modern repair shops and equipment.

The selection of machine tools, traveling cranes, small tools, jigs and fixtures can easily be made to meet any motive power requirements. The principal danger in the selection of machine tools is in giving undue weight to maximum performance of individual items.

The purchase and installation of special high-powered individual-purpose tools should be made only after the most minute analysis of the actual immediate and prospective requirements. Each expenditure in the way of machine tool facilities should be made so as to give the maximum return in the way of plant output and not considered on the basis of the output of the individual unit. Over-equipment of individual departments does not assist either the time or cost element of a locomotive which has to be passed through all the departments of the repair terminal.

Equipment Maintenance in Slack Periods

It is well to point out the fact that the railroads of this country have been, and now are, compelled to operate under serious handicaps in order to meet the current financial requirements necessary to keep them out of the hands of receivers.

A more specific explanation for the reasons resulting in this condition is readily found in either one or a combination of the following facts, all of which are subject to correction either by the railroads or the Interstate Commerce Commission.

First. The railroad companies appear to have purchased power at a higher ratio than the normal increase in tonnage available justified, causing power to remain idle.

Second. In the efforts of railroad officials to maintain a uniform ratio between income and expense, it is customary to reduce the maintenance of equipment appropriations during the slack months, thus causing the power in many cases, to be unavailable to take care of the peak load transportation in the fall and winter months without the assistance of the locomotive builders.

Third. Unfortunately, it has been the custom of motive power and transportation officials when purchasing new power, to endeavor to "keep up with the Joneses" by purchasing power in large sizes, and in a number of cases the tonnage available, yard facilities, bridge, and right-of-way limitations, and other local causes have prevented the full utilization of all of the extra drawbar pull available.

Fourth. Labor conditions, both in the transportation and motive power departments, have tended to decrease power and operating efficiencies.

Fifth. The amount of money expended by the railroads for logical repair shop facilities has been lamentably out of proportion with the amount of money expended for motive power and cars, resulting in inadequate facilities for needed repair and modernizing work. The reason for this is probably due somewhat to the fact that it is easier to secure financial assistance through car or locomotive trust certificates than it is to secure money on blanket or other mortgages to be used for the purpose of shop extensions or construction.

Sixth. The analysis of data from individual railroads shows that the purchase of power has in some cases been

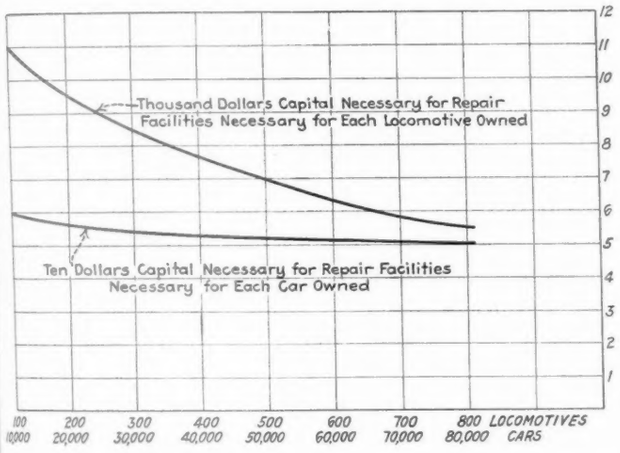


Fig. 1—Chart Showing Desirable Relation of Repair Facilities to Equipment Owned

justified and that the tons hauled per pound of available tractive power show decreases not out of line with changes in operating and labor conditions.

Taken as a whole, however, the figures clearly indicate a tendency to purchase power in advance of traffic requirements and further show inadequate provision for the roundhouse and general repair work necessary to keep the investment for power active.

Lack of Shop Facilities Delays Improvement Programs

The lack of adequate shop facilities is the greatest factor obstructing the purchase and application of modern fuel saving or other devices which would permit the increase of revenue ton-miles per pound of tractive power available. Lack of facilities to take care of such equipment when installed, and the fact of additional engine failures and delays has naturally resulted in the motive power department's being averse to take on additional obligations for maintenance with the fore-knowledge of inability properly to care for the same. As a matter of self-defense this tendency is a natural one, and as long as reasonably adequate supplies of tools and facilities are not available the position is well justified.

When the fact is taken into consideration that progress in locomotive development in the past few years has been almost entirely in the direction of devices which can be applied to existing power, and that the application of such equipment will make any existing locomotive as efficient as one of equal power just out of the builder's shop, the enormous size of the economic loss to the railroads can be visualized.

I am not an advocate of the attachment on the locomotive of every piece of apparatus that presents itself which theoretically might affect savings in operation, and I do not belittle the value of cold-blooded analysis of what the over-all economic results of each individual application will mean to the railroad organization as a whole. There are so many conditions of local operation which affect and govern, that each proposal can only be made the subject matter of intelligent decision by those intimately familiar with the governing factors.

A locomotive, when out of service for the most trivial cause, is just as expensive to the property as a whole as one legitimately tied up waiting for periodical over-hauling, and too much attention cannot be devoted to the necessity for adequate facilities. Each railroad should have every locomotive surveyed to determine if its useful life is actually finished through use or inadequacy, and if there is not the possibility of placing this engine on an equal basis with an engine just received from the builder, through application in its own shops of such modern improvements as superheaters, feed water heaters, cut-off indicators, brick arches, power reverse gears, valve gears, etc.

Trust Certificates Suggested for Betterment Work

Full capital account credit should be given for all betterment work and additions made to old power, and a new value placed on the entire locomotive after the completion of such betterments, in line with its ability to compete with a new unit of equal capacity, irrespective of its old arbitrary or book value. A market might be created for equipment betterment trust certificates to cover a proportion of the capital account betterment cost. Such certificates would have more equity behind them than if applied against new units, and would make available the necessary capital to rehabilitate railroad property with the advantage of utilizing in full capital previously expended.

Repair work should be equalized over the 12-months' period by arbitrary charges against income in the months of great business for credit and use during periods of revenue depressions.

Each purchase of new locomotive equipment should be made the subject of special study by the accounting, motive power and transportation officials assisted by outside advice if necessary, to determine: (a) Actual necessity, (b) size and capacity which will give the greatest net returns to the company, (c) type.

Locomotive purchases are in nearly all cases made at a time when erecting shop space is at a premium. This condition could be obviated by cold-blooded expenditures for repair facilities in combination with the scrapping of all papers relative to monthly budget allowance for maintenance of equipment work.

The railroad repair shops are usually operated at their peak during those months in which the cost of doing the work is at its highest, and what little organization remains in the spring time is engaged in hoeing the grass between the stones of the shop highways. The fluctuations in the pay-roll of both the classified and running repair shops are appalling, and these fluctuations are largely brought about by the month-to-month method of accounting and record-keeping in vogue by the transportation systems. Expending freely for maintenance account when earnings are temporarily good, at the expense of a starvation policy when earnings fall off due to natural seasonal conditions, is not a good business policy.

Explanation of Chart

This chart (Fig. 1) represents the amount of capital necessary for repair facilities, including yard, track, and

other work, for every locomotive added to the property.

For instance, a property having 500 locomotives should have, in the way of facilities for the repair and upkeep of these locomotives, property having a value of $3,500,000, and if 50 additional locomotives were purchased, the amount of money which should be expended for addition to the repair facilities is $6,700 for each locomotive, or $325,000 for 50, thus making the amount of money expended in facilities for the repair and upkeep of 550 locomotives $3,825,000.

Fig. 1 also shows the amount of money which should be expended for capital account purchases in the way of repairs, tracks, and facilities for the running and heavy repairs of freight cars. It will be evident that a property having 20,000 cars should have an investment of this nature having a value of $1,140,000 and in the event of the addition of 2,000 cars, $56.00 represents the amount of investment necessary to take care of each car, or a total of $112,000, thus making the total investment to take care of 22,000 cars $1,252,000.

Discussion

G. M. Basford (G. M. Basford Company): To me this paper seems one of the most important documents that has been presented before a railroad organization in many years. It calls attention in a marked way to the business question involved in taking care of equipment. The presiding officer spoke just now about the length of time required in getting up a new shop. That reminded me that my first important railroad work was laying out a shop in the drafting room. It was 26 years after that before the shop was built and during that time the particular railroad, the name of which I will not mention, did not have a real good shop. The locomotive deserves better care than that.

What are we going to do about it is a proper question at this point. Difficulty in raising capital for shop equipment prevents some roads from keeping up their machinery. Reluctance to invest their capital prevents financially comfortable roads from doing it. But the roads that become or remain strong financially will be the ones that keep a continuous flow of new shop equipment into their plants to protect their enormous investment in locomotives. These will be the roads that reduce operating costs by keeping up the condition of their engines.

C. B. Peck of the *Railway Mechanical Engineer* in a paper read before the Western Railway Club last month, supports the speaker by showing the relation between shop equipment and locomotive repair costs. As I remember the figures he shows that road B can afford to invest $9,000,000 in shop equipment to get its locomotive repair costs down to the figures of road A. He gives detail figures for both. But it is extremely difficult to find such a huge lump sum. The thing might be done in another way. It need not be done all at once. If road B had established a machine tool policy which for years past had added a few machines each month; if a plan and program had been made and each addition of equipment had been part of that policy, the savings each year would go toward an expansion of the policy the next year and road B would not be running away from the sheriff as Mr. Peck says it is right now.

There is nothing we need with respect to locomotives as much as we need policies, plans and programs. Three great operating items are affected and as indirectly suggested by the speaker of the evening are controlled by the facilities for locomotive maintenance. They are train crew wages, fuel and locomotive maintenance costs. The condition of locomotives directly affects fuel efficiency, overtime on the road and ton mileage. Locomotive condition is controlled largely by the equipment available to maintain the engines. These things are mentioned to show the necessity for a maintenance-of-equipment policy. How many roads have such a policy? Do they not wait and wait and then put in a lump of additional machinery after the head of the organization has been argued with and finally convinced? The cost is most prominent in his mind and he trims the list to bring it down. The thing is done and is regarded as finished.

As in many other business matters would it not be wise to make an annual budget and keep new machines coming regularly, uniformly and fast enough to be assimilated in the shop routine? In dull times machine prices fall. Machinery business like the locomotive business is a famine or a feast. Some day railroads will follow in machine purchases the plan followed by J. J. Hill as to cars. He kept a car plant going for years in dull times and when business came on he was ready to take business from his competitors.

It is my opinion that the officers of the railroads who have directly to do with locomotive and car maintenance have a great opportunity to put this idea into the form of a policy. I believe they can frame it with sufficient strength of argument to put it through right on up to the top and to make executives listen.

If these immense appropriations could be displaced by very much smaller ones providing systematically and regularly for steady improvement at frequent intervals, road B would not be in its present fix; another road would not let sixteen years pass without substantial additions to the machine equipment of a large terminal and another road would not allow ten years to pass without an adequate addition to the machine tool equipment at any of its shops. Another road would not require four months to repair an engine and perhaps would not now be in receivers' hands.

A little expense every year keeps a house in order. Waiting until it is a ruin keeps it always in bad order. Is it different in a shop?

E. L. Woodward (*Railway Mechanical Engineer*): I was impressed with the chart showing the relation between necessary maintenance and repair facilities and road equipment. Take for example a railroad having 800 locomotives and possibly 40,000 cars. On the basis of these curves, locomotive repair facilities should exceed $4,000,000 in value and car repair facilities $2,000,000. In far too many cases a railroad will have more equipment than that indicated above and fewer repair facilities. Added evidence of the lack of the proportion between present repair facilities and equipment on the road is given in Mr. Peck's paper previously referred to by Mr. Basford. In one instance mentioned the book value of the road was set at $400,000,000 and the total amount of shop and terminal facilities, including equipment, not over $16,000,000.

The lack of necessary repair facilities is a great detriment for several reasons, including (1) excessive cost of repairs, (2) equipment held out of service waiting repairs, and (3) delayed improvement programs. An important part of the cost of repairing cars and locomotives is labor cost, and it has been shown that this item practically equals the cost of fuel or the cost of crew wages in freight train operation. In order to decrease the cost of repairs to the point where it ought to be, labor-saving machinery must be installed.

Examples may readily be found illustrating how inefficient machinery decreases shop output. I was in a shop recently where an old wheel lathe was being used to turn tires, the feed being about 3/16 in. per revolution. The depth of cut was so small that several cuts had to be taken and it required seven hours to turn the pair of tires. A modern wheel lathe under the most favorable conditions can turn a pair of driving wheel tires in 30 minutes and an average of one pair an hour can easily be maintained. It is not infrequent to find truck wheels turned on large engine lathes, in which case one tire only can be turned at a time using small cutting feeds and speeds. Old planers are still in operation with no side heads and sometimes with only one cross rail head. I was in another shop not long ago where tube holes in a front flue sheet were being cut on an ancient radial drill. This ma-

chine was badly worn, of low power and was not forcing the high speed cutters to anywhere near their capacity.

Not only are inefficient machines being used, but in many cases modern methods of machining cannot be utilized for the lack of necessary tools. For instance, many shops are not adequately equipped with grinding machines. These machines have already demonstrated their value and are now made powerful enough to machine parts from the rough stock in a short time. The work is exceedingly accurate, rapidly finished and smooth enough to form the best of bearing surfaces. Similarly with milling machines, important economies can be effected by their more general use in railroad shops. Engine lathes also should not be forgotten and on account of being so much more commonly used than turret lathes, special lathes, etc., they should be of the latest and most efficient design. Centralized production departments should be developed and facilities provided for repairing steel cars. Railway power plants in the United States are variously estimated at from 1,200 to 1,800 in number, and we all know how infrequently they benefit by new equipment or modern testing apparatus.

The present relatively high wages make improved shop machinery and equipment absolutely essential to economical shop operation. In 1912 I began work at 28 cents an hour in an air brake room on the Boston & Maine. Even should the present machinists', boilermakers' and blacksmiths' rate be decreased from 77 cents to 67½ cents as proposed, this rate will still be 100 per cent higher than it was in 1912. Are present shop facilities 100 per cent better than in 1912?

Who is to blame for the present lack of repair and maintenance facilities? It is easy to blame the Interstate Commerce Commission or the public or business conditions, but the trouble is not entirely there. The mechanical department itself is to blame in no small measure for present conditions because its needs are not sufficiently emphasized. Mr. Caracristi refers to the weak voice of the mechanical department. The voice of the mechanical department is not only weak, but it is not heard often enough.

What is the remedy? The mechanical department has a good case which should be presented forcefully and continuously until results are obtained. The savings possible by additional repair facilities, including new machinery and equipment, should be estimated accurately with recommendations based on specific and comprehensive data from which no factor is omitted. Present the recommendations without fear and push them on every possible occasion. If possible, get the higher officers out in the shop or roundhouse and show them actual conditions, pointing out the needs. A much stronger impression will result.

Bad shop and terminal conditions in this country are considered a necessary evil and taken too much for granted. I feel that the lack of money for shop improvements is also sometimes taken too much for granted. Prompt improvement would follow a more careful and more frequent expression of shop needs. Tell the boss. I would suggest that this paper by Mr. Caracristi be taken home and given serious attention in the hope that we may all realize more fully how important a factor shop operation is in railroad operation and what a direct influence it has upon the general business prosperity of the country.

F. C. Pickard (D. L. & W.): How to go after machine tools? Take your labor charge together with your time element and if you can show from 15 per cent up in savings and put your argument up to the right people on the job in the shop, you usually get results. Recommendations mold, get dusty and go into the waste basket. I find that if you can take the man who has the authority to fix the A.F.E. right down in the shop and talk to him and show him where it is a profitable investment, you can usually get the tool you want. We replaced a machine the other day that took two men two eight hour tricks to keep up with our daily routine. The installation of the new machine paid 24 per cent on the investment. We now do the job in three eight-hour days and when that argument was presented it was not very hard to get our people to purchase the new tool. We have practically a definite plan throughout the year on expenditures for machine tools.

Important economies are derived from laying out a yearly program. Our forces are adjusted so that the horizontal line will just about neutralize the up and down peaks of high and low business and when the year is over, we have a uniform force of men in the shop. We have had about a uniform distribution of material for the year and this plan is more successful than that of making appropriations based on monthly business. The average railroad makes a large appropriation proportional to the volume of business and it should be reversed so that the amount of money for shop operation should be low when the business is high. You want your locomotives on the road and your cars moving when business is good and when it is poor they ought to be repaired and put in shape to care for the business when it comes along.

I have watched a large number of shops throughout the country and it has been my observation that the shop with about 15 pits shows a better operation than one with 35 or 40 pits. A good deal of the heavy expenditures in the large shop are due to overhead. You can talk of the hourly rate of mechanics and its relation to shop production, but the biggest thing that I see and that we have got to deal with is classification and a stipulated amount of work to be done in a shop. I would just as soon pay a dollar an hour if I get the work done, but I don't want to pay a dollar if I only get 25 cents' worth of work. There must be some plan laid down whether you call it a bonus system, piecework or something else, so that you can tell a man he has got to go from "A" to "B" for a day's work. In other words, mechanical men would produce a whole lot better results if they didn't have both hands and feet tied with labor together with labor contracts, laws and regulations, as they have at the present time. We have got to the regulating point with our labor contracts where it is strangulation.

H. C. Woodbridge (Rochester, N. Y.): Unfortunately, it seems to fall to my lot to be a crepe hanger or a critic. The author says, "In other words, had each pound of tractive effort been utilized at the same efficiency as in 1902, there would have been a large surplus of locomotives during these peak periods." Mr. Caracristi spoke of the opportunity for criticizing that word efficiency. Personally, I am sorry that he used it. I am afraid that such paragraphs coming from members of the railway clubs, and especially perhaps from a consulting engineer, will furnish material for those who are are belittling the efforts of railroad officers. I do not like the word and I wonder how much is taken into consideration in developing that efficiency.

The writer and Mr. Pickard hit the anvil on the head when they said, "Get the line uniform and let the peaks up and down balance each other." This is a wonderful paper but we ought to be careful how we talk before these trouble makers who take our words and twist them.

Mr. Caracristi: I agree thoroughly with Mr. Pickard with regard to large shops, but do not agree that 15 pits is the economical limit. A shop can be made unwieldy in size and I think a lot of trouble with the large shop has not been on account of the shop itself, but on account of the lack of rounding out requirements. We all know of shops with good machine tool equipment but lacking in jigs and fixtures necessary to get the work out of them.

I regret that Mr. Woodbridge did what I was afraid a lot of you would do—take a wrong slant at my comparison on the basis of efficiency. I pointed out in another portion of my paper that the 1902 locomotive based on its tractive power could be made just as efficient as the 1920 locomotive

and that is the basis on which the whole paper is written. Given the proper repair facilities, your locomotives can be made as efficient. There has not been a thing developed which has increased the efficiency of the locomotive from a fuel consumption standpoint that cannot be put on an old locomotive just as it can be on a new one.

A Successful Welding Job

By Charles A. Norton
Moncton, New Brunswick

THE following is a description and illustration of an acetylene welding job which was successfully completed in the shop here a short time ago the details of which may be of interest as showing the possibilities of acetylene welding. The work was done by welders from the boiler shop.

Reference to *A* in the illustration shows the broken cylinder and in the lower left corner the patch which was carefully machined and shipped ready to be put in position and welded. The patch is shown on a somewhat smaller scale in the picture but its proportion and general design are plainly indicated. The cylinder flange was put in place and the patch applied in the correct position for welding. The outside of the cylinder was then cased with thin sheet metal as shown at *B* and the space between this casing and the cylinder proper filled with asbestos. A four-pipe gas heater was then placed inside the cylinder and the patch and cylinder end allowed to heat slowly. The time taken to preheat the job was about three hours.

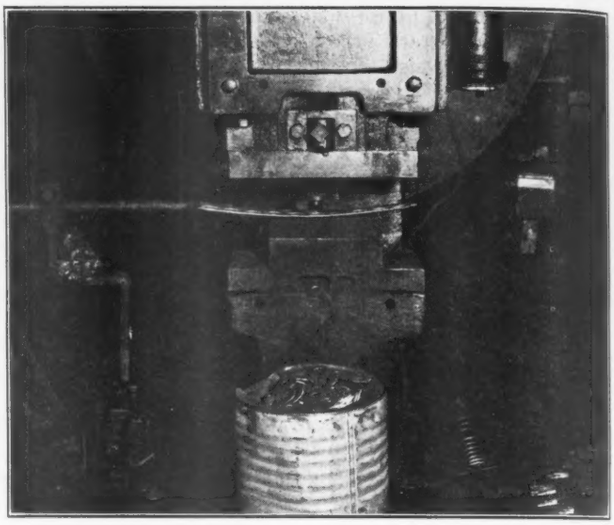
After the heater was withdrawn two welders began work and by working alternately they were able to keep the metal running continually which prevented any void being formed by a stoppage of work for one cause or another. The acetylene gas welding tanks are shown at the right of *B*, mounted on a truck for convenient movement about the shop.

The patch weighed 140 lb. and four hours of continuous welding was required to apply it to the cylinder. Approximately 38 lb. of welding rod was used, and the cylinder as finally rebored ready for application is shown in *C* in the illustration. Inasmuch as the crack came directly in one of the cylinder stud holes it was necessary to apply two additional studs one on either side of the crack and drill corresponding holes in the cylinder head.

Making Washers from Old Flues

By S. J. C.

The illustration shows an interesting method of utilizing scrap boiler flues in the manufacture of washers at a relatively low cost. Dies have been made for punching ½-in., ⅝-in., ¾-in. and ⅞-in. washers of which many hundred pounds are used in railroad shops annually. The old flues are flattened out under a steam hammer and punched, two



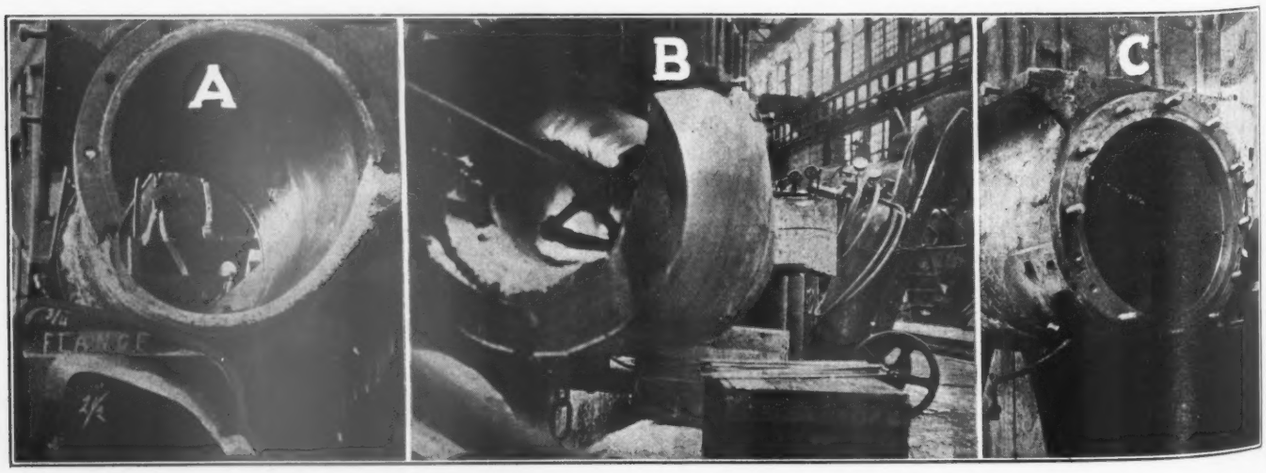
Two Washers Are Formed at Each Stroke of the Punch

washers being secured with each revolution of the punch. The cost of producing washers by this method is as follows:

Labor to handle and flatten flues	$0.30 per 100 lb.
Labor of cutting and handling flues	.31 per 100 lb.
Labor or punching washers	.55 per 100 lb.
Scrap value of flues	.50 per 100 lb.
Total cost	$1.66 per 100 lb.
25 per cent overhead	.415
Grand total	$2.075 per 100 lb.

This figure effected a very satisfactory saving in washers compared with the price during 1919 and 1920, which was an average of $5.425 per 100 lb. In July, 1921, the price of washers went down to a point where it was inadvisable to continue manufacturing them from scrap stock and the present quotation on washers averages $1.84 per 100 lb.

The worker flattening out flues and punching washers is paid a mechanic's rate on account of the rules handed down by the United States Labor Board and while this work is relatively unskilled and could be performed by laborers as well as mechanics, the latter must be employed. If it was permissible to use laborers, washers could be cut from scrap stock with a saving below even the present market price.



Three Views Showing Preparation, Preheating and Completed Acetylene Welding Job

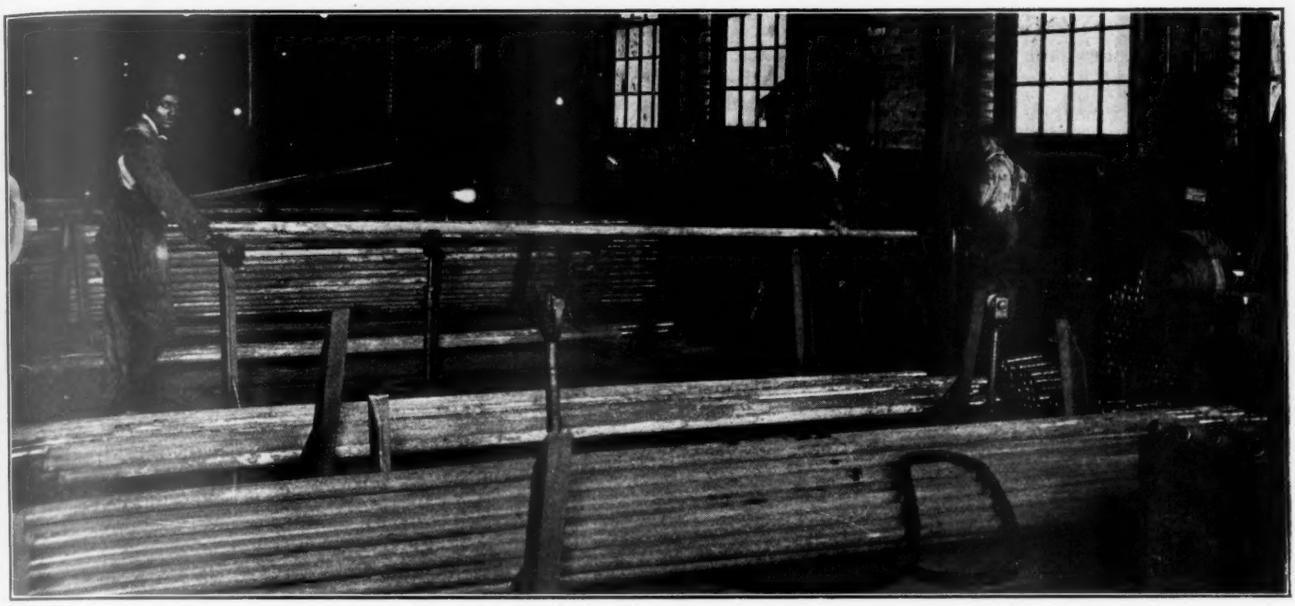


Fig. 1—View of Well Organized Flue Shop

Installing and Maintaining Charcoal Iron Locomotive Boiler Tubes

By G. H. Woodroffe* and C. E. Lester†

THERE is a correct way to apply a boiler tube, and an incorrect way. With certain tools the necessary operations may be performed efficiently, with minimum time and labor costs. Done with tools less suited to the work, the application is not only unsatisfactory but the service life of the tubes is materially shortened.

In the interest of better tube service and lower tube costs we have prepared the following recommendations for the application and maintenance of charcoal iron boiler tubes, arch tubes and superheater flues. From the standard practices of a number of railroads we have taken what we believe to be the best and have incorporated it in this recommended practice. In this work we have been guided by the suggestions of practical railroad men, whose cheerful assistance and valuable co-operation are gratefully acknowledged. Methods of applying boiler tubes, and the tools employed, vary considerably on the different railroads. Whatever the procedure the various operations must be performed with care and thoroughness. The tools used must be properly maintained.

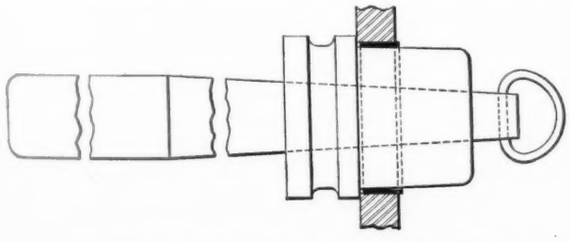


Fig. 2—Setting Copper Ferrule in Tube Sheet

Note.—Copyright by the Parkesburg Iron Company. This suggested practice will be published in book form later and is subject to revision.

*Mechanical Engineer, The Parkesburg Iron Company.

†Formerly General Superintendent, 19th Division, Transportation Corps, A. E. F., and Superintendent of Nievre Locomotive and Car Shops.

Tubes should be made tight in the flue sheet with the least possible working. Once a tube is really tight, excessive working will not make it more secure. On the contrary, it will injure the metal and adversely affect the service life of the tube, making early renewal necessary.

A roller expander is not recommended for use on the firebox end of tubes, except possibly for a light finishing hand operation. The roller crushes the metal of the tube, thinning it out and reducing its resistance to the demands imposed by service.*

Application of Body Tubes

Preparation of Back Tube Sheets—Holes for body tubes in the back tube sheet should be the same diameter as the outside diameter of the tube, both edges being rounded to a radius of 1/16 inch.

Preparation of Front Tube Sheets—Holes in the front tube sheet should be 1/16 inch larger than the outside diameter of the tube except that two holes, 5/16 inch larger than the outside diameter of the tube should be left about 12 inches above the bottom row of tubes in the center, in order to facilitate the removal of badly scaled tubes. All holes should be clean and the outside edges rounded to a radius of 1/16 inch.

Ferrules for boiler tubes should be soft copper, 1/32 inch longer than the thickness of the back tube sheet.

Ferrules must be of the same outside diameter as the tube and should be 0.0625 (1/16 inch), 0.08 and 0.09 inch thick. For new work, ferrules should be 1/16 inch thick, the heavier copper being used after the tube holes have become enlarged through service. This practice permits the use of a standard swage. Copper ferrules may be softened by annealing.

Reaming Tube Holes—When a firebox sheet tube hole becomes 1/8 inch out of round, ream it with a straight

*The word tubes, used in the following pages, refers to body tubes. By flues are meant "superheater tubes or flues."

reamer. When it becomes enlarged through service to 3/16 inch above outside diameter of tube, scrap the sheet.

Preparation of Firebox End of Tubes—Swage the firebox end of the tube with a slight taper toward the end of the tube to ⅛ inch less than the outside diameter of the tube, so as to drive snugly in the ferrule after the ferrule has been tightened in the sheet. Length of swaged end should be the thickness of the tube sheet plus ¼ inch.

Preparation of Front End of Tubes—Cut tubes to length. The front ends should be expanded hot, to such a size that when placed in the boiler they can be driven snug in the front tube sheet. This should not be done to tubes that are to be transferred (put through one hole and set in a different location) in the boiler.

The ends of the two tubes that are to be placed in the enlarged holes may either be expanded hot to the required

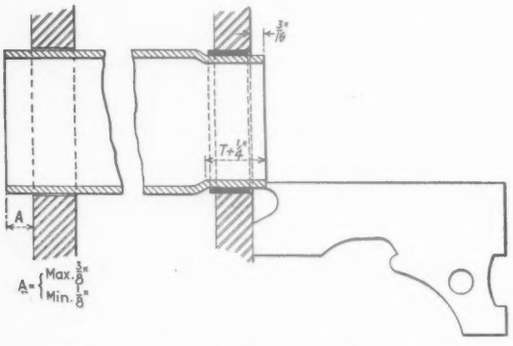


Fig. 3—Proper Position of Tube in Sheet

diameter or have a piece of tube of larger size, 12 inches long welded on.

Setting Ferrules—Place ferrules in the tube holes in the firebox sheet, 1/32 inch from the fire side. Tighten with straight sectional expander, Fig. 2, or roll with roller expander.

Placing Tubes—Clean the firebox ends of the tubes and place them in the tube holes in the firebox sheet, fitting them neatly into the copper ferrules.

Be careful not to injure or displace the ferrules.

Tubes should project through the firebox sheet 3/16 inch, as measured by the gage, Fig. 3. The projection through the

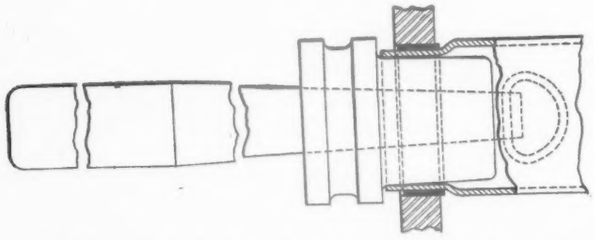


Fig. 4—Method of Tightening Tube in Back Tube Sheet

front tube sheet should be ¼ inch. It must not be less than ⅛ inch nor more than ⅜ inch.

Tightening Tube in Sheet—Tighten tubes in the firebox sheet with a straight sectional expander, Fig. 4.

Tightening Front End of Tubes—Next tighten the front end of the tube with a standard roller expander, Fig. 5.

Flaring Tubes, Preparatory to Beading—The firebox end of all tubes, and on superheater engines the front ends of the two rows of tubes just below the superheater flues and all tubes above these two rows, should be opened with a flaring tool, Fig. 6. Use a long stroke pneumatic hammer.

Expanding with Lipped Sectional Expander—Expand the firebox ends of the tubes with the lipped sectional expander shown in Fig. 7. Drive the expander pin lightly until it is fairly solid. Draw out the pin. Give the expander a turn equal to half a section of the expander. Drive the pin a second time. Withdraw it, and turn the expander a distance equal to one-quarter of a section. Drive the pin a third time. Care should be exercised in the use of the expander in the outer rows of tubes near the heel of the flange to avoid cracking the sheet. Use a long stroke Boyer No. 60 pneu-

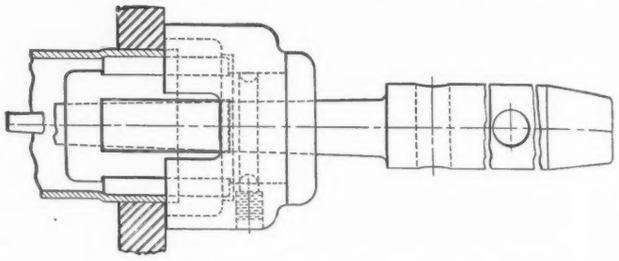


Fig. 5—Rolling the Tube in the Front Tube Sheet

matic hammer (a heavier hammer is not recommended) in driving the pin or its equivalent.

Inspection for Split Tubes—After expanding, examine the tubes carefully. Those which have split in the shoulder formed by the lip of the expander, and tubes that have opened from the end back to the sheet, should be removed and replaced before beading.

Opening Front End of Tubes—If the front end of the tube has not been opened hot before placing in the boiler, a straight sectional expander should be used to tighten the tube in the sheet. The tube may then be rolled with a standard roller expander.

If the finger type roller expander is used, the use of the straight sectional expander is not required.

Beading—Firebox ends of all tubes must be beaded, Fig 9.

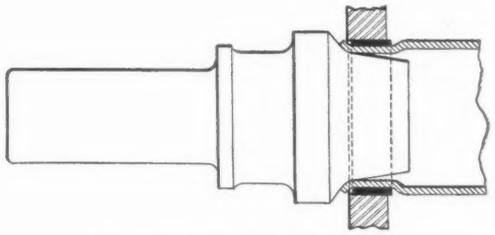


Fig. 6—Method of Flaring Tubes

Use a short stroke pneumatic hammer. Take care that nothing enters between the bead and the tube sheet. In superheater locomotives the front ends of the two rows of tubes just below the lower row of superheater flues and all tubes above these rows must be beaded similarly.

Hold the beading tool so as to give the bead an outward set and get it down to the sheet without raising a burr on the inside or marking the outside of the sheet with the heel of the beading tool. The center line of the beading tool should always be inside the line of the tube. Remove any burrs that may be raised with a small chisel and hand hammer. If necessary, the firebox ends of the tubes may be rolled lightly after beading.

Tools—All beading tools must be maintained within the limits of standard gages. Lipped expanders should be stamped to show the thickness of sheet on which they are to be used and should be taken out of service when worn or distorted to such an extent that they will not force the tube squarely against the sheet.

Application of Superheater Flues

Preparation of Back Tube Sheet—Holes for superheater flues in the back tube sheet should be 4⅝ inches, both edges being rounded to a radius of 1/16 inch.

Preparation of Front Tube Sheet—Holes in the front tube sheet should be 3/32 inch larger than the outside diameter of the flue and the outside edges should be rounded to a radius of 1/16 inch.

Copper Ferrules—Ferrules must be made of soft copper, 1/32 inch longer than the thickness of the tube sheet. Ferrules must be of the same outside diameter as the holes in the tube sheet and should be 0.0625, 0.08 and 0.09 inch thick. For new work, use ferrules 1/16 inch thick, the

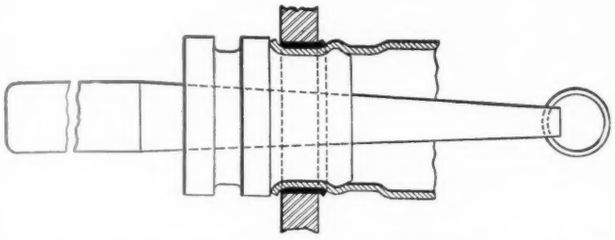


Fig. 7—Lipped Sectional Expander Used to Expand the Firebox End of Tubes

heavier copper being used after the holes become enlarged through service.

Preparation of Firebox Ends of Flues—Firebox ends of flues should be swaged to a diameter of 4½ inches. The straight portion should be 5 inches and the tapered portion 3 inches long, as in Fig. 10. Remove all scale and burrs before placing the ends in the tube sheet.

Preparation of Front End of Flues—Cut flue to length. Expand front end, hot, to a diameter 1/16 inch greater than the outside diameter of the flue, as in Fig. 10.

Setting Ferrule—Place the ferrules in the flue holes in the back tube sheet 1/32 inch from the fire side and tighten with the roller expander, Fig. 11.

Placing Flue—Place flues in the holes in the back-tube sheet, fitting them neatly into the copper ferrules. In placing flues, be careful not to displace copper ferrules. Flues should project through both sheets ¼ inch to allow for beading, Fig. 10.

Rolling Flue in Back Tube Sheet—Tighten flues in the

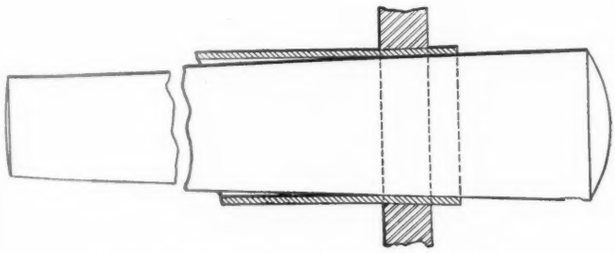


Fig. 8—Pinning Out the Front End of a Tube

back tube sheet with a roller expander. The roller expander shall have not less than 5 rollers, Fig. 12.

Flaring Flues in Back Tube Sheet—A flaring tool, because of its size and weight and the force necessary to drive it, is not recommended for superheater flues. Superheater flues should be flared by a four-pound peining hammer.

Expanding Flues in Back Tube Sheet—Expand firebox ends of flues with lipped sectional expander of not less than 12 segments, Fig. 13.

Drive the expander pin until it is fairly solid. Draw out the pin and give the expander a turn equal to one-half of a section of the expander. Drive the pin a second time. Withdraw it. Turn expander a distance equal to one-quarter of a section. Drive the pin a third time. Use a long stroke pneumatic hammer in driving the pin.

Rolling Front Ends of Flues—Tighten the front ends of flues with a roller expander, Fig. 14.

Flaring Front Ends of Flues—A flaring tool, because of its size and weight and the force necessary to drive it, is not recommended for front ends of flues. Front ends of flues should be flared by careful blows of a four-pound peining hammer.

Beading Superheater Flues—Bead the flues at both ends, Fig. 15, using a short stroke pneumatic hammer. Take care to see that nothing enters between the bead and the sheet. Hold the beading tool so as to give the bead an outward set and get it down to the sheet without raising a burr on the inside, or marking the sheet with the heel of the tool on the outside. The center line of the beading tool should always be inside the line of the flue. Remove any burrs that may be raised with a small chisel and hand hammer.

Tools—All beading tools must be maintained within the limits of standard gages. Lipped expanders should be stamped to show the thickness of sheet on which they are

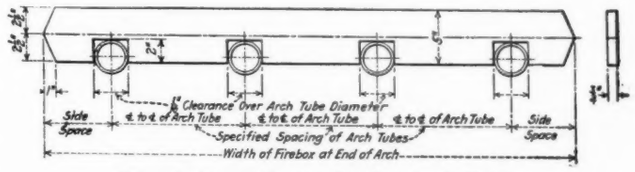

Clearance Over Arch Tube Diameter
Side Space
℄ to ℄ of Arch Tube
℄ to ℄ of Arch Tube
℄ to ℄ of Arch Tube
Side Space
Specified Spacing of Arch Tubes
Width of Firebox at End of Arch

Fig. 18—Template for Gaging Arch Tubes

to be used and should be taken out of service when worn or distorted to such an extent that they will not force the tube squarely against the sheet.

Application of Arch Tubes

Preparation of Sheet—Sheets must be properly straightened. Holes for arch tubes must be circular and drilled 1/32 inch larger than the outside diameter of the arch tube. Outside edges should be rounded to a radius of 1/16 inch.

If the arch tube hole has become enlarged above normal size in service, measure it carefully, so that the tube can be heated and enlarged to fit the hole snugly before being applied. If this is not possible a copper ferrule may be used extending ¼ inch on the water side and flush with fire side of the sheet.

Preparation of Arch Tubes for Setting—Cut arch tubes to proper length, with an allowance of ½ inch at either end for flaring. They should be smooth at the ends and free from burrs. They should be formed in accordance with drawings for the various classes of locomotives. Particular attention should be given to bending, in order to prevent the formation of steam pockets in service due to improper bends to make certain that the arch tubes enter the sheets at an angle of

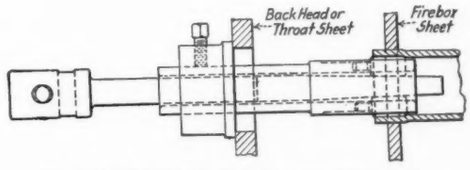


Fig. 19—Clamping Device for Arch Tubes

90 degrees, Fig. 16, and to avoid flattening which would not only weaken the tube but might cause an obstruction and keep the turbine cleaner from going through.

Setting of Arch Tubes—Arch tubes should be set in position, the proper amount projecting through the sheet for flaring and held with a clamp similar to Fig. 17.

It is recommended that a spacing gage, Fig. 18, be used to insure correct alinement of arch tubes.

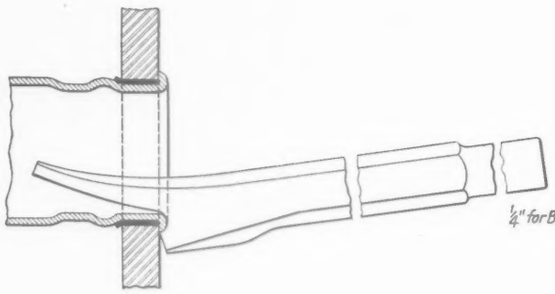


FIG. 9

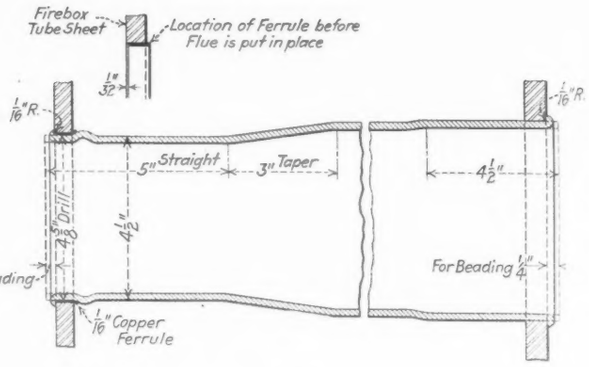


FIG. 10

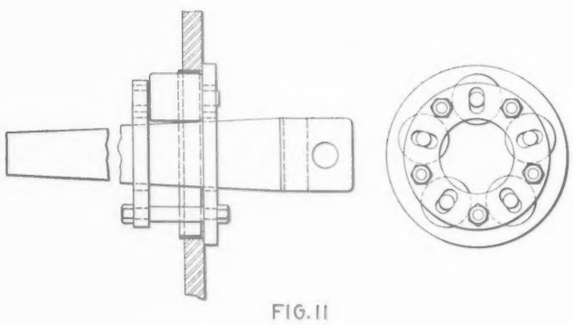


FIG. 11

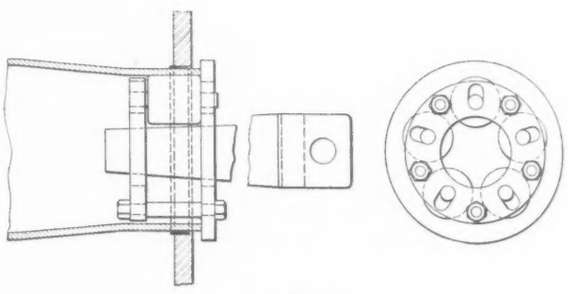


FIG. 12

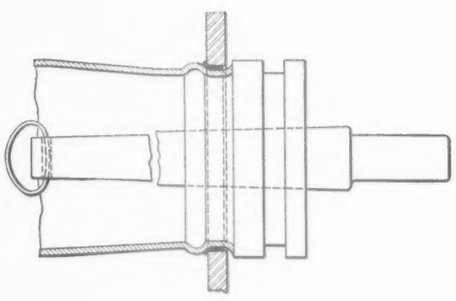


FIG. 13

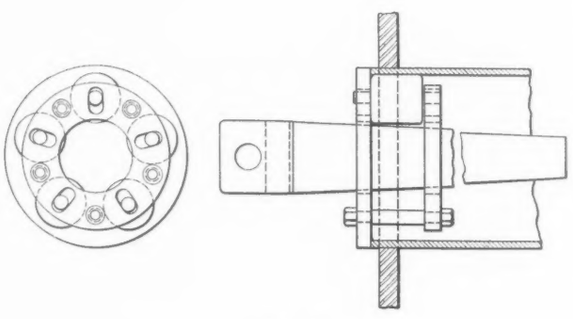


FIG. 14

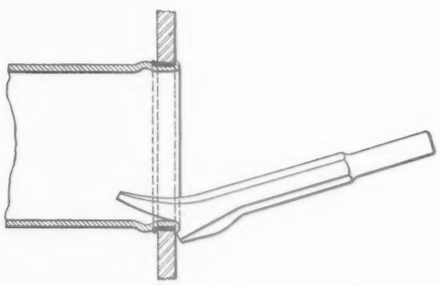


FIG. 15

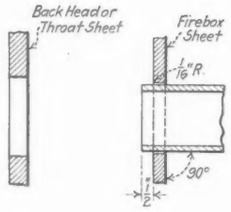


FIG. 16

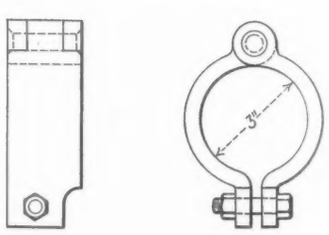


FIG. 17

Fig. 9—Beading Tubes. Fig. 10—Correct Application of Superheater Flues. Fig. 11—Setting Ferrules. Fig. 12—Setting Superheater Flues. Fig. 13—Expanding Flues. Fig. 14—Rolling the Front End of Flues. Fig. 15—Beading Large Flues. Fig. 16—Proper Position of Arch Tubes Entering Firebox Sheet. Fig. 17—Arch Tube Clamp.

Rolling—Arch tubes should be rolled into the firebox sheets, this operation being performed at the bottom end first. By using a collar on the housing shaft, as shown in Fig. 19, proper location of the rolls can be insured.

Flaring—Arch tubes should be flared on both ends. The tool shown in Fig. 20 is recommended for this operation.

Inspection—When the engine is in service the arch tubes should be inspected every trip. At every boiler washout the arch tubes should be washed out, bored out with a turbine cleaner, and the ends in the water space inspected for possible defects.

At any time should an arch tube be found to have a pocket, or warped to any extent, the arch tube should be removed. Whenever a clinker or other substance is found attached to an arch tube the clinker should be removed and a careful inspection made of both the outside and inside of the tube.

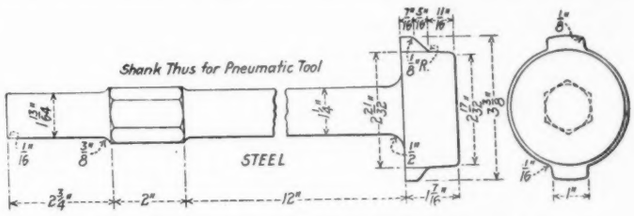


Fig. 20—Arch Tube Tool Recommended for Flaring Ends

Specialized Training Versus Apprenticeship

"Railroads Cannot Be Run Without Men. They Are Not on the Market. They Must Be Made."

By L. E. Gardner

IN an editorial in the December, 1921, issue of the *Railway Mechanical Engineer,* under the title of "Specialized Training vs. Apprenticeship," you suggest that if apprentice courses cannot supply the required number of skilled mechanics for railway service, "some other means, such as part-time instruction, should be provided for training employees in order to develop efficient workers in each special field." This suggestion would be most fitting and opportune if it were possible to give shop employees such specialized training. But it is not clear to the writer what class of shop employees are to be given this training. As we understand it, the United States Labor Board has divided railway shop employees into the following classes: supervisory forces, skilled mechanics, apprentices, helpers and common laborers.

Foremen Should Be Trained

If you have reference to training of supervisory forces, your point is well taken. "Increased output and the flexibility of the organization" would more than "justify the small expenditure necessary to carry out such a plan." In too many shops insufficient care is taken in the selection of foremen and no effort is made to develop the latent talents such men possess. There is a mistaken belief that foremen are born, not made. It is true that some men are born and grow up with characteristics which give promise of leadership just as other men are born with characteristics, or grow up in an environment, that gives promise of the man becoming a successful lawyer or a skilled surgeon or physician. But no one would think of trusting his legal affairs to a "natural born" lawyer who had not received special training to develop his latent natural talents or to enable him to profit by the experiences of others of his profession. Certainly we could not conceive of turning a "natural born" surgeon loose in a hospital to work out his own salvation, or our destruction.

Is it not equally true that the "natural born" foreman should receive training that will develop his latent talents and enable him to profit by the experiences of other foremen. A man is not permitted to run a machine without first receiving instruction and training. There is more to learn about handling men than about handling machinery. Railways have much to learn about the possibilities in foremen training.

Skilled Mechanics Should Not Be Neglected

But I do not think you had reference to training of supervisory forces. Possibly you had in mind specialized training for the skilled mechanics, men already receiving full rate of pay in the various crafts. There is a much greater field here than is generally supposed. Many of these are very inefficient and poorly prepared. Particularly those whom the Railroad Administration made mechanics overnight by a stroke of a pen. But not only these but all others have much to learn. Just as a competent physician learns something every day of his practice, so can the skilled mechanic learn something every day he works at his trade. It is to the interest of his employer that he keep abreast of the times and learn of improved methods. Money spent in his training will bring ample returns, but it must be spent judiciously owing to the restrictions of the seniority rule adopted by the Labor Board, which prevents employers from placing these men in work for which they are best fitted.

But I do not think your editorial had reference to men already classed as skilled mechanics, but rather to methods of recruiting mechanics and increasing the supply. So let us consider the remaining classes of shop employees whom you may have had in mind for specialized training.

Helpers and Common Labor

Passing over the apprentices, the only other classes to be considered are the helpers and the common laborers. Under the rulings of the Labor Board, these men are not permitted to do, or to learn how to do, any phase of mechanics' work. They may carry the mechanics' tools and do the lifting, but must not be permitted to screw on a nut, or perform any work whatsoever that is classified as mechanics' work. Except for the few advanced to apprenticeships, "once a helper always a helper."

There was a time when the brighter and more capable helpers might be advanced to handymen and eventually to mechanics. At such a time specialized training for this class of employees was in order and likewise very profitable. But under present rules and working conditions it is absolutely tabooed. Unless possibly for some physical training to develop the muscles of his back, the helper of today, if not given an apprenticeship, has no need of and would be unable to use either to his own or the company's advantage any other training given him.

Where Will Future Mechanics Come From?

This leaves no other possible way of developing railway mechanics except through the training of apprentices, either regular or helper apprentices. This should be clearly under-

stood. The situation is a serious one. It is absolutely impossible under present rules and working conditions to recruit mechanics through any form of specialized training of any class of employees other than apprentices. The day of the specialist is past. No one can be employed as a railway mechanic who has not had four years' experience on mechanics' work unless he first serves an apprenticeship. Railway officials should realize this and prepare to meet the situation. Those who fail to do so are not only leaving to others a duty they ought to perform but are themselves committing industrial suicide. Where are future railway mechanics to come from, if they do not come through apprenticeships?

Statistics issued by the Labor Board show the number of mechanics in railway shops to have doubled in the four-year period in which a mechanic could be developed through an apprenticeship. Similar increase in the number of mechanics exists in other lines of industry. If the supply of mechanics is to be maintained, some means must be devised for recruiting not only enough new material to take the places of those dropping out but also to take care of the constantly increasing number needed. The most casual study of labor turnover will show the number dropping out each year to be much greater than generally recognized. Some die or are incapacitated on account of illness or other physical disability. Others go back to the farm or choose some other occupation. Still others, while continuing to work at their trade, go into other lines of industry. The drain to the automobile industry has been most noticeable. With the increased number of automobiles, the development of aviation and the further use of farm tractors and other machinery, the drain on the limited supply of skilled all-around railway mechanics will be even greater. The places of these men must be filled. But how, and by whom?

Labor Board Is Wrong

We have shown the only available source is through the training of apprentices. But even here there are unfortunate restrictions. Although the survey made by the Railroad Administration showed a very low ratio of apprentices to mechanics throughout the country, the Labor Board has ruled that not more than one apprentice may be employed for each five mechanics in service on any division of any railroad. This means much less than a ratio of "one to five" in the total number to be employed, for many divisions will necessarily fall far below the established quota, and their allotment cannot be employed elsewhere.

But let us consider this ratio of one to five further. We wonder where it originated and in what way this ratio was determined. Certainly it was not calculated to supply a sufficient number of mechanics. More likely the aim was to create a corner on the market. A ratio of one to five means 20 apprentices for each 100 mechanics of the craft. It would take each of these 20 apprentices four years to become a mechanic. If everyone of them completed his course, this would provide only five mechanics each year; that is, five per cent of the total number of mechanics employed. But it can no more be expected that all of these apprentices will complete the course than that all entering high school or college will complete their course. It would be a conservative estimate to say that at least half of them will drop out for one reason or another. This would leave an average of only 2½ mechanics to be recruited each year for each 100 mechanics in service. Does anyone think a supply of 2½ per cent each year will begin to take care of the labor turnover, to say nothing of the increased number needed each year in any growing industry?

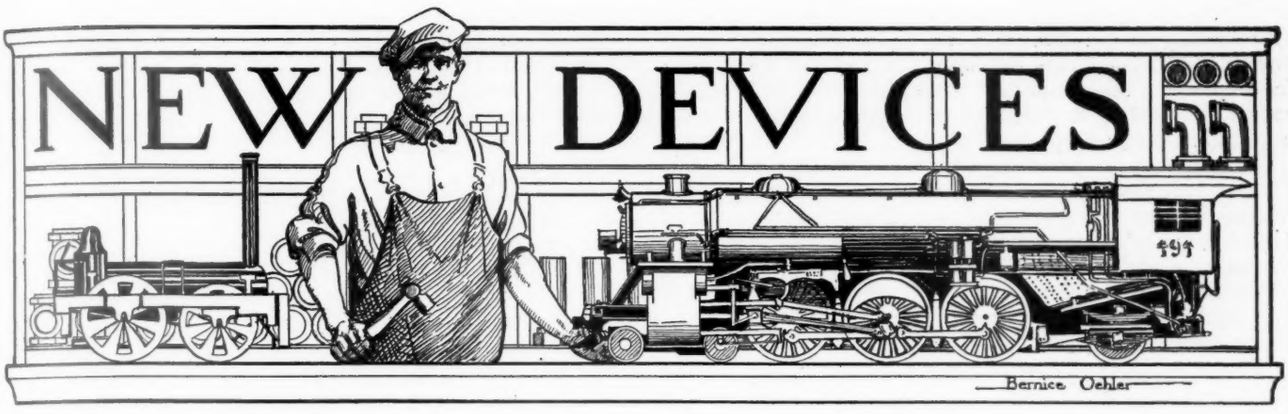
But in order to prepare even this small percentage of mechanics each road must employ its maximum number of apprentices. Think it over, men. If you can't get good material for apprenticeships, you had better take what you can get and do your best to make something out of them. But do not be discouraged if the majority of applicants are foreigners. Many of these if rightly trained will develop into the very best of mechanics and amply repay the effort necessary to develop them.

Remember, too, that the quality of applicants attracted to your courses will be in direct proportion to the opportunities offered towards developing them into skilled all-around mechanics. Those roads which have maintained up-to-date modern apprenticeships have experienced no difficulty in securing desirable applicants but instead have a lengthy waiting list from which to choose. The thing is contagious. As one boy finds that he is being well treated, given thorough instruction, regularly advanced from one class of work to another and all-in-all is being taught a worthwhile trade and being thus fitted to earn a comfortable livelihood, with opportunities for promotion, he tells his friends and they tell theirs. Soon there is no longer a dearth of competent applicants but instead an abundant supply from which the most promising may be selected.

We could go further and show that in addition to recruiting mechanics for future needs, the increased output in work performed by apprentices together with the numerous other benefits derived from a thorough course of training will more than justify the cost of the training given. But when it is understood the supply of railway mechanics cannot be maintained through specialized training of any class of employees other than apprentices, and that at best even when the full quota of apprentices is employed not more than two or three per cent of the total number of mechanics can be trained or developed each year, surely it will be seen that every effort should be made to maintain at all times the full quota of apprentices in all trades.

Neither is it sufficient merely to *employ* these apprentices. They must be kept in service and graduated. They cannot take the place of the mechanics who drop out unless they themselves remain in service and complete the course. They cannot perform the work unless they have been properly trained. Railroads cannot be run without men. The right kind of men are more difficult to obtain than are materials or machinery. They are not on the market. They must be made. Each road must do its part and do it thoroughly. The Labor Board should be persuaded to remove its obnoxious restrictions. Meanwhile the railroads should make full use of the limited opportunities offered for developing these men. Otherwise, effiecient transportation will be endangered.

Elwell-Parker Electric Station Truck in Use on Government Railway, Japan



Ingersoll Adjustable Rotary Milling Machine

A VERTICAL milling machine with longitudinal, transverse and rotary milling feeds, and vertical spindle feeds for boring and drilling has been placed on the market for the Ingersoll Milling Machine Company, Rockford, Ill. This machine has been developed especially to handle the general class of rod end work usually performed on slotters and embodies a rigidity of construction, plainly indicated in Fig. 1, which insures smooth operation under extremely heavy cuts. It consists of three major parts; the bed, the table saddle and rotary table, and the spindle housing. The bed is a one-piece casting of box section with two sets of ways at right angles of each other, one for the table saddle and one for the spindle housing. It is open at the rear to receive the motor which is enclosed under the housing, thus making the machine entirely self-contained.

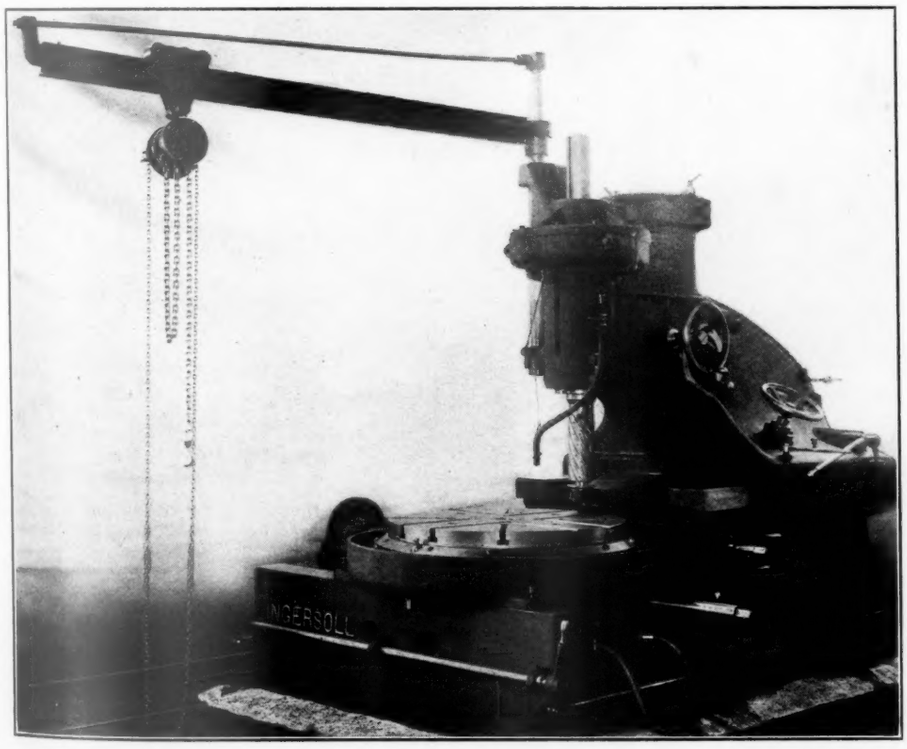


Fig. 1—Ingersoll Vertical Milling Machine with Longitudinal, Transverse and Rotary Feeds

The machine is conveniently controlled by the operator from a position where he may closely watch the progress of the cut. This is particularly important in profiling irregular surfaces such as are encountered in rod end work. The rotary table feed, the saddle feed and the spindle housing feed all receive their power from a single take-off from the main shaft, thus making it possible to control the starting, stopping and quick return for all these feeds with a single lever. This lever, which is mounted on the spindle housing, has three positions: the direct feed, neutral and quick return. The movement of the lever from the feed position through neutral to the quick return position automatically reverses the direction of travel and causes the cutter to move away from the work at the rate of three feet per minute, making it impossible to jam the cutter into the work in the ordinary operation of the machine. The direction of the feeds is reversed by a double clutch operated by a lever mounted on the bed under the forward end of the housing way. Another lever at this location controls the housing feed through a clutch, while the engagement of the table and saddle feeds is controlled by a lever located below the end of the saddle way. The spindle is provided with power feed downward only and a quick return through operation of the main feed control lever. The hand feeds of the spindle and the housing are controlled by hand wheels mounted on the housing. In the case of the latter, the hand wheel rotates the nut on the power feed screw through a worm connection which automatically locks the nut against turning when the power feed is in operation. A dial gage on the hand feed makes possible the adjustment of the housing to .001 in.

The illustrations show a number of typical operations for which the machine is particularly adapted. In milling out the jaw in the side rod knuckle connection (Fig. 2) a solid cut was taken at a cutting speed of 100 r.p.m., using a three-fluted helical milling cutter 2¼ in. in diameter. This cutter was fed into the solid metal at the rate of ⅝ in. per minute, the face of the cut measuring 12¾ in. over all at the widest part. On this cut the motor delivered a maximum of 24 hp. The roughing cut left ⅜ in. of stock on each face which was removed in finishing

cuts feeding at the rate of 1 11/16 in. per minute. On another lot of eight rods this operation required a cut 10⅜ in. deep with a maximum face across the full diameter of the rod ends of 11⅝ in. The entire lot was finished in 16 hours, including set-up time.

The sides of the knuckle joint tongue on four main side rods of heat treated alloy steel, requiring two cuts per rod ⅛ in. deep by 10⅜ in. wide with a maximum travel of 11½ in., were finished with a feed of 2½ in. per minute for the body cut and ¼ in. per minute for the radius at the base of the tongue. The four rods were completed in 3 hours and 45 minutes, including the set-up time, and the spiral cutter was operating at a speed of 60 ft. per minute.

The inside faces of a heavy main rod strap (Fig. 3) were rough milled from the solid block with the 2¼-in., three fluted cutter at the rate of one inch per minute. The face of the cut was 5½ in. deep and the total length of the cut in along one side, across the end and out along the other side, was 74 in. In finishing the outside faces of these straps, with a depth of cut varying from ¼ in. to 1⅜ in. the work is performed with a feed of from 1 in. to 1½ in. per minute. In these heavy cutting operations the lower end of the cutter is supported in an outboard bearing mounted on a bracket which in turn is bolted to the end of the spindle housing.

In machining the openings in the crosshead end of main

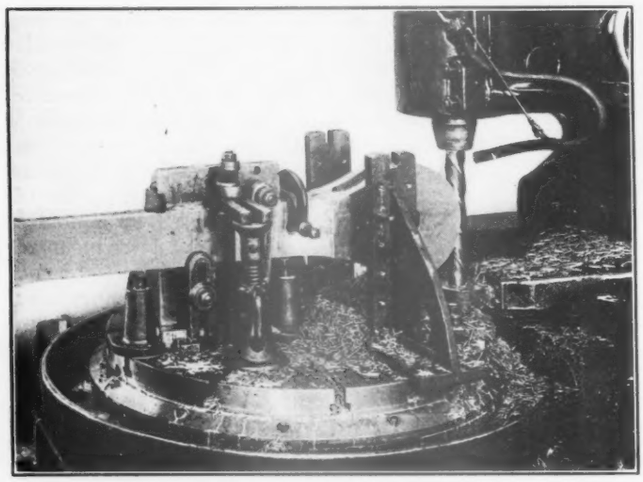


Fig. 2—Milling Jaw in Side Rod Knockle Pin Connection

rods the cut is prepared by setting up the rods on the miller, drilling a single hole at one corner of the opening, large enough to receive the helical milling cutter and milling around the edges as laid out. The solid block is then removed without further drilling, leaving sufficient stock on the surfaces for a smooth finishing cut. This operation was performed on a pair of heat treated chrome vanadium steel rods, machined together, in 4 hrs. 30 min., including set-up time. The opening for the wrist pin brasses was 6¾ in. wide by 8 in. long and the wedge slot 2¼ in. wide by 4¾ in. long. The face of the cut on the two rods was 10¼ in. The roughing cut progressed at the rate of ¼ in. per min. and the finishing cut at the rate of 1½ in. per min.

In profiling circular surfaces of rod ends (Fig. 4), the rods are drilled and mounted on mandrels centered on the table and machined by the use of the rotary feed.

The principal features of the construction of this machine are clearly indicated in the illustrations. In the interest of rigidity and accuracy the longitudinal and cross feeds have been separated and both are guided directly on the bed. The table saddle is carried on 7-in. horizontal bearing surfaces with a spread of 40 in. over the shears. The alinement of the table is maintained by a single inside gib, and two clamps bearing on the under side of the ways are provided on each side. The table illustrated is 42 in. in diameter but as the result of extensive service trials this diameter has been increased to 54 in. The diameter of the table bearing on the saddle is equal to that of the table and is four inches

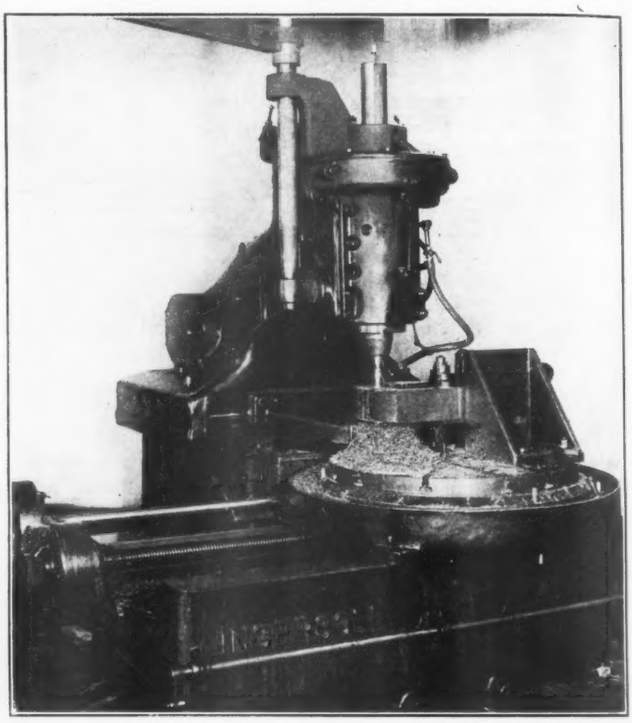


Fig. 3—Finishing Inside Surfaces of a Main Rod Strap

wide radially. A ring clamp, completely surrounding the table and bearing in a recess in its edge, secures the table to the saddle when the rotary feed is not in use, thus in effect providing the rigidity of a one-piece casting for straight work. The hole in the center of the table is bushed to pro-

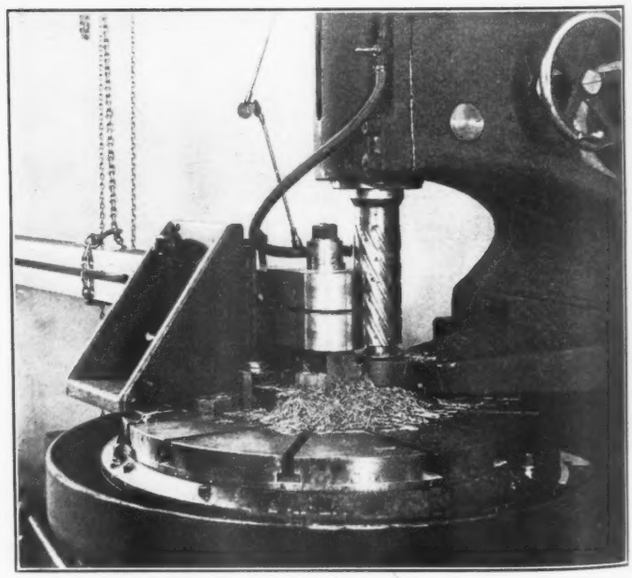


Fig. 4—Profiling Front Ends of Main Rods, Using the Circular Feed

vide a boring bar guide when taking heavy boring cuts. The table saddle has a longitudinal travel of 44 in. from a position with the center of the table 16 in. to the right of the spindle center to a point 28 in. to the left of the center.

The cross feed is effected by the movement of the spindle housing on 8-in. ways with a spread of 46 in. over all. The alinement of the housing is maintained by two gibs, one on each way, and one clamp, bearing on the under side of the bedway, is provided on each side. The total travel of the housing is 30 in.; the center of the spindle at the forward limit is one inch in front of the center of the table. The spindle housing carries all of the speed and feed changes, with the gears located in two oil tight pockets in the casting. The spindle is 6 in. in diameter at the largest taper and has a 10-in. flange. It is carried in a 10-in. quill which has a vertical movement of 21 in. The spindle is driven by a herringbone gear 20 in. in diameter and 3¼ in. wide. This gear is specially heat treated and runs in grease. The lower face of the spindle housing is 25 in. above the top of the table and when extended to the lowest position the spindle is 4 in. above the table.

The machine has an operating range of nine spindle speeds and nine feeds. The spindle speeds progress at a ratio of 1.4 from 10 to 120 r.p.m., and the feeds range from ¼ in. to 10 in. per minute at a ratio of 1.6. In each case three mechanical changes are provided and two sets of feed change gears and two sets of speed change gears are furnished with the machine. For the three medium speeds and the three medium feeds the gears in each set bear a one to one ratio. In each case the ratio of the other set is reversible and this set is used for both the high and low ranges. The feed gears operate in conveniently accessible compartments on the back side of the housing. An additional set of change gears doubles the feed range of the rotary table. These gears are enclosed in a box at the rear end of the saddleway. Large size shafts have been used throughout the feed mechanism in order to reduce to a minimum the possibility of chatter under cuts which approach the capacity of the cutter.

The machine is driven by a 25-hp. General Electric alternating current motor, operating at 1,160 r.p.m. It is also fitted with a pump for the circulation of the cutter lubricant, carried in a tank of 30 gallons capacity built in the bed.

New Crane Truck and Charging Plug

THE Elwell-Parker Electric Company, Cleveland, Ohio, has recently developed an electric truck with a carrying capacity of 3,000 lb. and revolving counterbalanced crane of unusual length. The crane is a handy, portable device for hanging smoke box doors, or air pumps on locomotives in shops or engine houses. It is also adaptable to use in storerooms to handle castings, lighting generators and other parts which can be safely and easily stacked, reducing the storage space usually required.

Fig. 1—Elwell-Parker Truck with 8-Ft. Outreach Power Crane

The heavy vertical steel column, shown in Fig. 1, has a long bearing in a pedestal bolted to the steel platform on the truck, and supports a 12-ft. boom which may be racked in or out by the operator without leaving the driving position. The hoist is operated by a separate motor direct-connected to an enclosed hoist mechanism. The controller is located on the dash in front of the crane operator. The hoist is mounted on a steel frame which houses the battery, the battery, hoist and motor all acting as a counterbalance. A special trip switch mounted on the front of battery box stops the inward motion of the boom as set.

The crane is designed to pick up 1,000 lb. at an 8-ft. outreach, or with outriggers in position as shown 3,000 lb. at 6-ft. outreach. The boom may be lowered to permit entrance of doorways. The outriggers are quickly adjusted, folded and swung in beside the crane column when not in use.

The truck is equipped with 21½ in. by 3½ in. drive wheels and 15 in. by 3½ in. trailing wheels, all four of which steer. Large wheels permit use in yards. A coupler is furnished on the rear to permit using the unit for intermittent tractor service. Motors, differential worms, wheels and crane pillar column are all fitted with ball bearings. A single battery furnishes power to propel the truck as well as to operate the crane.

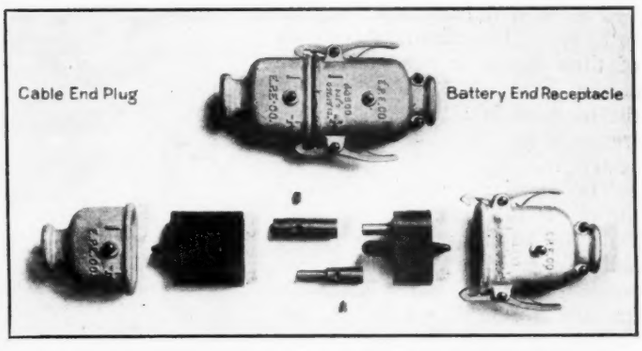


Fig. 2—Improved Battery Charging Receptacle and Plug

One of the smaller though important details of a truck is the attachment or charging plug. Every battery is equipped with the receptacle or battery end of this plug and interchangeability is of prime importance.

The Elwell-Parker Electric Company has recently made improvements in these charging plugs, as shown in Fig. 2, without interfering with their interchangeability.

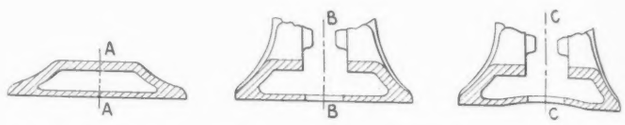
The new charging plug shells or cases are equipped with latches for holding the two halves rigidly together while the truck is in motion. The addition of these latches prevents bending or loosening of the telescoping terminals with consequent burning or arcing.

Moulded Bakelite insulation is used in making up the

inserts. The terminals are removable and are held in place by filister head screws, so that terminals can be furnished separately, for use in an old insert. Wires are soldered into the terminals, thus forming a perfect electrical connection, whereas previously wires have been clamped in place by machine screws and connections sooner or later come loose causing heating and arcing. This heat was transmitted to the telescoping end of terminals, thus effecting the current carrying capacity of the plug as a whole. New inserts can be used in old shells, thus assuring interchangeability.

Jack Base Designed for Maximum Safety

UPON the ground bearing or foundation of a jack depends the safety of the men who are using it. If through constant use under heavy loads a jack base becomes set upward at the circumference, the jack has a tendency to kick out under the load and is a menace to safety. In an effort to overcome this condition many jacks have been built with extra heavy bases but the resultant uneven distribution of metal often produces checks and stresses in the castings during its cooling or annealing. With the idea of correcting these defects Templeton, Kenly & Company, Ltd., Chicago, have developed the base illustrated for use on Simplex jacks. In this case the base instead of being a heavy solid section is cored, or made hollow, without increasing its height or weight. Being made of malleable iron cored, it presents a comparatively thin base section which conforms to the line of pressure and forms a concave base transmitting to its rim the burden of the load. The illustration shows a section through the base at the toe *AA* and also through the center at *BB* together with a view of the base *CC* after continued use and pressure have produced a permanent set.



Cross Sections of Simplex Jack Base Showing Improved Design

Pipe Threading and Cutting Machine

A PIPE threading and cutting machine has recently been added to the line manufactured by the Landis Machine Company, Waynesboro, Pa. This machine embodies important features of modern machine tool design and has a range from 4 in. to 12 in. It may also be equipped to thread and cut pipe as small as 2½ in. Two die heads are employed, a 6-in. die head for a range from 4 in. or 2½ in. to 6 in., and a 12 in. head for a range from 6 in. to 12 in. The entire range of each of these heads is covered by but one set of chasers. The length of the machine is 11 ft. and the extreme width is 5 ft. It weighs 13,000 lb.

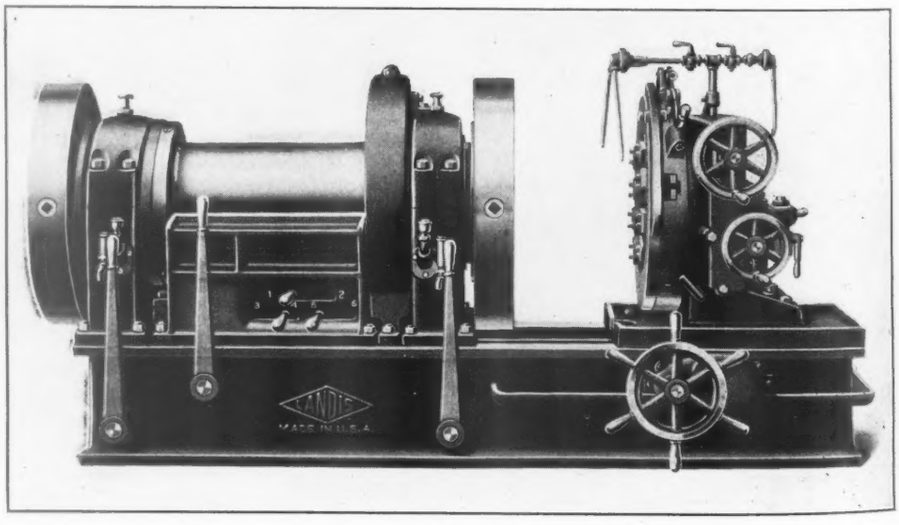
The carriage which supports the die head, the cutting off tool, and the reaming tool are moved either by power or by hand. The power traverse or movement is both forward and backward and is controlled by a lever located on the operating side of the carriage. In advancing the carriage toward the chuck, the lever is pulled and held until the threading position for the die is reached. In reversing the movement of the carriage, the lever is pushed forward and held. Releasing the lever stops the carriage at any point within its travel.

Automatic stops prevent the die head from coming in contact with the chuck in the forward movement and the carriage from running off the guides of the machine in the backward movement. The reaming tool is quickly set to position and locked with a lever.

The machine has a single pulley drive and is started and stopped through a friction clutch by either one of two levers located at the extreme ends of the head stock. This enables the operator to start or stop the machine when threading or when fitting up flanges. Eight speed changes are available. A lever is located midway between the starting and stopping levers for reversing the machine.

The chucks for gripping the pipe have three geared jaws with universal adjustment. Chucks are also self-centering to the pipe, the rear one being equipped with flange grips for fitting up flanges. All gears are fully enclosed and, with the exception of the main drive gear and its pinion, all gears run in oil. The main bearings are lubricated with flat link chains which run in oil contained in large reservoirs. The driving pinion shaft as well as the reverse shaft are lubricated by sight feed oilers.

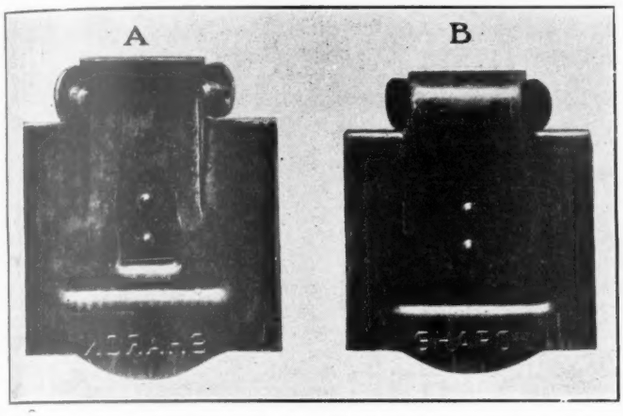
The machine can be converted to motor drive by replacing the pulley with a sprocket and fitting a plate to the side of the machine for mounting the motor. A silent chain is employed to drive from the motor to the sprocket.



Landis Pipe Threading Machine with Range from 4 to 12 In.

Pinless Type Journal Box Lids

THE journal box lid illustrated is a new product of the Sharon Pressed Steel Company, Sharon, Pa., being made of cold drawn steel and furnished in two types, outside and inside. The outside type of lid with flanges has a groove across the face and hood and is pressed from one piece of material, thus tending to give it great strength, as well as affording maximum protection from dust and moisture. The inside type of lid without flanges has a depressed groove fitting within the box opening, designed to give it strength equal to the outside type of lid.



Sharon Pinless Journal Box Lid Which Can Be Applied with a Hammer

Both types of lid have a hook notch at the bottom to facilitate raising for the inspection of journals and both lids are fitted with flat springs, shown at *A*, designed to hold the lid securely closed under all ordinary operating conditions. The pinless feature of these lids provides a convenient and easy method of attaching without the use of pins or bolts. When such are used, lids are frequently applied by the use of a smaller bolt than is intended for the purpose, thereby giving a loose fit and improper spring action. The new construction also does away with the usual scrolls at the top of the lid.

The pinless type of lid is attached by means of a strap, stamped and formed from a single piece, as shown at *A* and *B*, having lugs extruded to fit the standard bolt holes in the top lug of the journal box. These lids are supplied with the lugs in extended position and, being fitted by a car repairman, are secured in place by forming over the two projections on the hood with an ordinary hammer. When this type of lid is struck by some obstruction, the strap will be deformed and the lid proper, undamaged, can be easily salvaged by fitting with a new strap.

Wire Brush Cleaner for Removing Paint

THE increasing use of air-driven wire brushes for cleaning metal surfaces has demonstrated the need of high rotative speed. Especially has this been true on such cleaning work as the removing of paint, rust, dirt and scale from tanks, steel cars, structural steel forms, etc., where the area to be cleaned is large and a fast rate of work is required. It has been found that a wire brush turning at high speed cleans faster and also stands up to the severe service much better than if only revolving at 2,000 or 3,000 r.p.m.

The Ingersoll-Rand Company, New York, has recently brought out a high speed cleaner (Fig. 1) known as the No. 601 Little David wire brush, which has a maximum speed of 4200 r.p.m. This machine is said to be unusually successful in operation, effectively cleaning surfaces such as mentioned above and also iron and steel castings. It is designed to do a first-class cleaning job and effect a considerable saving of time and labor as well.

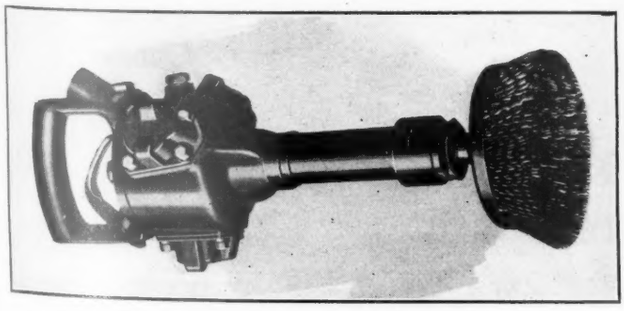


Fig. 1—No. 601 Little David Wire Brush

On a six weeks' test this machine cleaned steel gondolas, each averaging 540 sq. ft. of surface, in 3½ hours. All-steel box cars (Fig. 2) each averaging 1,400 sq. ft. surface were cleaned in 7½ hours. The air motor is of the three-cylinder type such as used in the Little David portable grinder which has been thoroughly tested out in the severe service to which pneumatic grinders are subjected. The machine is designed to be simple in construction, well balanced and operate without vibration. Light weight has been attained by using an aluminum casing reinforced with cast-in steel bushings. The weight of the complete machine is 14 lb.; the average free speed at 90 lb. air pressure, 4,200 r.p.m.; the length overall, 17½ in. and the diameter of the wire brush, 6 in.

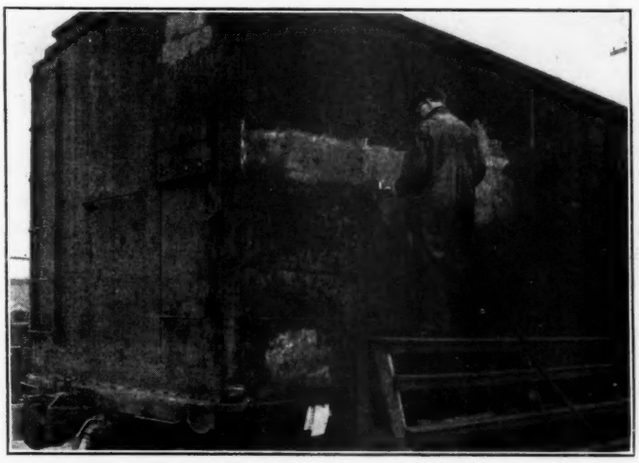


Fig. 2—Example of Method of Using Pneumatic Wire Brush Cleaner

In many of the larger car shops the use of sand blasting equipment has been developed as an economical method of removing paint but where this equipment is not available the wire brush, rotating at high speed, is an effective method of cleaning off paint.

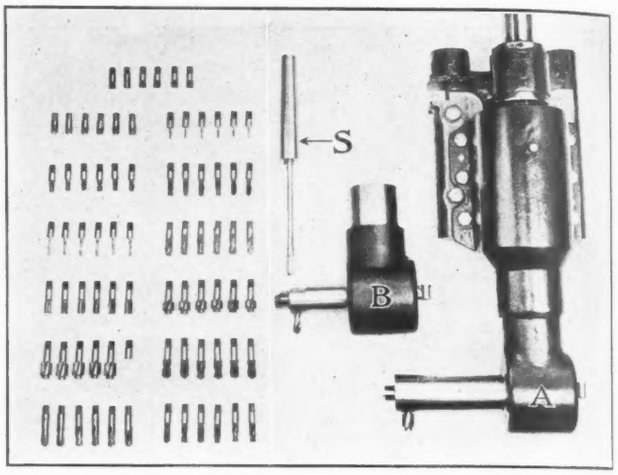
Interesting Development for Offset Drilling

THE Harris Engineering Company, Bridgeport, Conn., has developed recently an offset drilling attachment for drilling, milling, countersinking and counterboring port holes and grooves in air tools, such as pneumatic hammers, drills and riveters. This attachment is made to reach into the main bore and drill or mill the vents or ports from the inside. It is possible to drill to a specified depth; also to counterbore or mill circular, transverse or longitudinal slots. Special shank drills, mills and counterbores are ground and lapped to fit the spindle in the outer end of the arm and run true, they are readily changed and have a limited adjustment for depth to allow for grinding, setting, etc.

In the illustration is shown an offset drilling attachment *A* mounted in a special bracket on the vertical slide of a Becker vertical milling machine. Just to the left is another attachment *B* with a smaller arm for use on smaller work. This is interchangeable in the special bracket with the arm shown in the bracket.

The driving spindle *S* has a taper shank fitted to the machine spindle and at the lower end it is squared to drive the offset attachment. It will be noted that this is necked down in diameter between the squared end and the taper shank. This is to give increased elasticity and also to provide a point of failure to prevent jamming of drills, mills or fixtures due to accident or carelessness.

These offset attachments may be efficiently used for other purposes requiring inside drilling or milling, such as oil grooves, straight or spiral holes for holding babbitt in bearing boxes, end milling blind keyways to retain a feather or key in a hub sliding on a shaft, etc.



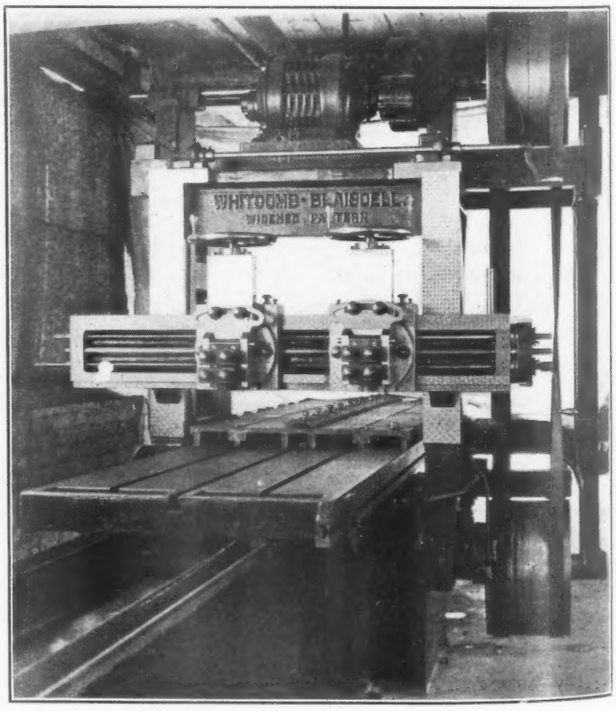
Harris Offset Drilling Attachments and Tools

At the left of the photograph is shown a varied assortment of drills, end mills and counterbores for use in these fixtures.

High Speed Second Belt Drive Planer

THE illustration shows a 26-in. by 32-in. by 18-ft. planer, recently brought out by the Whitcomb-Blaisdell Machine Tool Company, Worcester, Mass., and designed to operate at unusually high speeds by means of a second belt drive feature. Equipped with a 30-in. driving mechanism this machine operates at a cutting speed of over 100 ft. per min. Planers from 17 in. up to and including the 30-in. machine are provided with this feature, the object of which is to simplify construction, maintain as nearly as possible a direct drive without sacrificing power and thereby increase the machine efficiency. The pulley shaft carrying the tight and loose pulleys extends clear through the bed to the opposite side of the planer. Mounted on the end is a small pulley known as a second belt pulley. Forward of this and running on a hardened steel stud is a larger pulley carrying a spiral pinion, known as the intermediate pulley and pinion. On the end of the driving pinion shaft is mounted a spiral gear which meshes with the intermediate spiral pinion. Power is conveyed between the two pulleys by means of an endless double belt known as the second belt which is kept taut by an adjustable idler pulley.

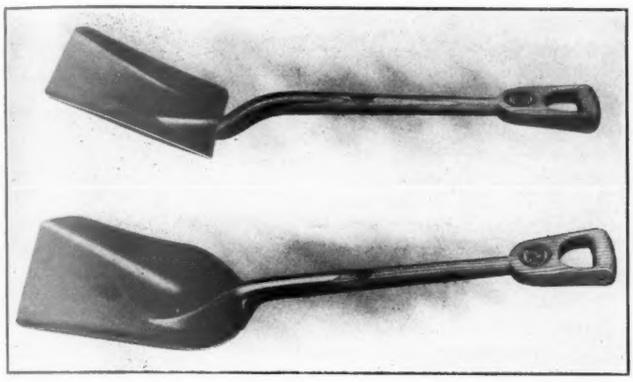
By this construction the bull wheel and usual trains of gears inside the planer bed are eliminated, with the exception of the pinion driving the table rack. The advantages are the elimination of noise and wear due to rapidly running gears and a more smooth action imparted to the planer. Also the use of the second belt allows unusually high cutting and return speeds. The new planer is said to run quietly and easily and reverse gently yet promptly. Elimination of the gear train does not reduce the ratio of drive belt speeds to table speeds, which is still maintained at a high ratio. There is a considerable saving of power due to eliminating the friction in a train of gears and machine efficiency is thereby increased. In numerous cases where brass, copper or other soft material is to be planed the machines are said to have run at 150 ft. per min. cutting and return speeds. The resultant increase in production is self evident and the high table speeds are accomplished without sacrificing quiet, smooth action.



Whitcomb-Blaisdell Planer Featured by Second Belt Drive

Molybdenum Steel in Shovel Construction

A MOLYBDENUM steel scoop for firing locomotives and stationary boilers has been placed on the market by the Wood Shovel & Tool Company, Piqua, Ohio.



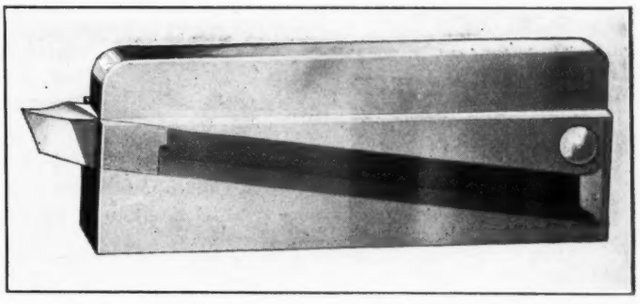
Track Shovel and Fireman's Scoop Made of Molybdenum Steel

The blade of the scoop is made of molybdenum steel, especially treated to give great hardness combined with remarkable toughness. The greater strength of molybdenum steel permits lighter construction with its resultant saving of energy for the worker. A feature of the new scoop is the welding of the straps to the blade, making the two parts virtually one. The bolts are countersunk into the handle which is of seasoned second-growth northern ash. The rigidity of this construction assures long life in actual service.

The molybdenum shovel is made in different types, one being designed for track maintenance and similar work. In designing the track shovel, the manufacturers recognized the fact that it is frequently used in place of a sledge or a crowbar in addition to its normal function, hence, a shovel was constructed designed to stand up under the gruelling strain and abuse of track maintenance service. Shovels made of the new alloy have been subjected to rigid tests by the Wood Shovel & Tool Company and demonstrated conclusively the value of molybdenum steel for shovel construction.

Holder for Short Cutters of High Speed Steel

THE tool holder shown in the accompanying illustration has been developed by the Lovejoy Tool Works, Chicago, for using up the short ends of high speed steel cutting tools. The device, known as the Use-Em-Up tool holder, is made up of two parts hinged together with a pin at the rear end. The lower part or base of the holder is channeled out to receive the tool bits, the bottom of the channel being considerably deeper towards the rear end than at the forward or cutting end. The top member fits in this channel, the clearance between it and the bottom of the channel being such that when clamped in the tool post the bit is held near the front end. This permits the bit to be used up until its length does not exceed ¾ in., but does not interfere with the use of bits of any greater length desired. The holder as shown is 4 in. long and 1½ in. in height, designed to take bits ⅜ in. square. It can be used in the tool posts of lathes, shaper, planers and other tools, affecting important savings over the cost of solid high speed steel tools.



Lovejoy Holder for Long or Short Tool Bits

Efficient Locomotive Cab Ventilating Set

THE problem of locomotive cab ventilation is a more or less serious one, especially on roads where steam locomotives are required to operate in tunnels. An unusually interesting method of solving this problem has been developed by the B. F. Sturtevant Company, Boston, Mass., the essential part of the apparatus being the ventilating set illustrated. These sets have been applied in one case to the locomotive cabs of Mallet locomotives operating in districts where tunnel clearances are close and the grade adverse to the movement of trains. According to a prominent officer on the road in question the transfer of Mallet locomotives to one of the branch lines where the conditions described above existed resulted in forcing attention to the problem of locomotive cab ventilation. Experiments were conducted in an effort to provide better ventilation and it was found by using the Sturtevant electrically-driven ventilating sets, two units to the locomotive, the atmospheric conditions in the cab could be materially improved.

Sturtevant Cab Ventilating Unit

The ventilating sets were operated electrically by an electric headlight turbo-generator installed for the purpose. Two sets were applied to the locomotive, located under the boiler ahead of the firebox. The intake from the fan gathered the air at a point about 6 in. above the track. One fan delivered air to the right side of the locomotive immediately in front of the engineman and the other to the left side. In order to get the best results, it was found necessary to

make the cab as nearly airtight as possible so that the fresh air delivery inside the cab would create a pressure in excess of that surrounding the cab, thus preventing the foul gases from entering.

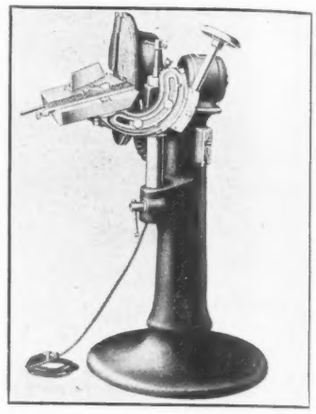
Sturtevant portable ready-to-run ventilating sets are made in five sizes running at speeds up to 3,400 r.p.m. and delivering from 58 to 1,440 cu. ft. of free air per min., depending upon the size.

Disk Sander Saves Time and Labor

FOR accurately sanding pieces such as segments, angles for built up work, core prints, taper work and sanding and fitting small pieces in pattern and cabinet shops, the disk sander illustrated is well adapted. This machine is direct motor-driven with a capacity to sand circular work up to 15 in. in diameter and has been placed on the market recently by the Oliver Machinery Company, Grand Rapids, Mich.

The machine is portable, can be placed near the operator and is featured by ease of operation, rigid construction and adaptability to a wide range of work. It makes bevel joints and fits faster than can be done with a chisel and plane. It is used for sanding leather and compositions, for metal grinding and polishing. An exhaust system deposits dust within the column. The 15-in. diameter steel plate is turned true and carefully balanced and is mounted on a disc shaft hub. It is movable for renewing sandpaper by loosening a clamp on the swivel post, swinging the table to the right, and slipping off the center pin. The speed is 1,725 r.p.m.

The disk head is a one piece iron casting containing the disk, disk shaft, ball bearing end thrust and exhaust fan in one complete unit. The table is 9¼ in. wide by 21 in. long and 37 in. above the floor. It is arranged as indicated to tilt 45 deg. down and 25 deg. up by means of a handwheel, worm, worm segment and segment which is self locking. The table has vertical adjustment of 6 in. and will swing to the right to take off the disk. With the combination gage provided, circular, segment and duplicating work can be readily performed. A suitable 1, 2 or 3-phase, 110 or 220-volt motor, running on ball bearings, is arranged to drive the disk shaft but does not take the thrust load. The machine is operated by a push button.



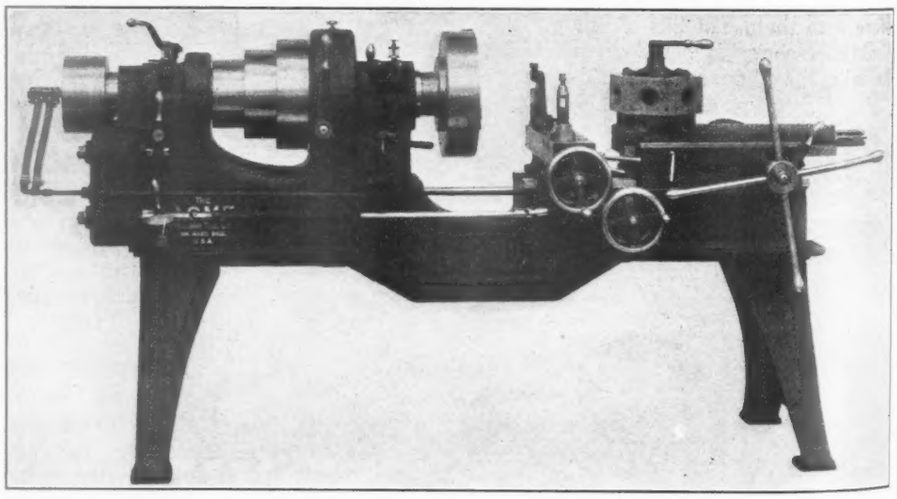
Oliver Disk Sanding Machine

Gap Feature Applied To Turret Lathe

AN interesting departure from the standard design of turret machinery has been made by the Acme Machine Tool Company, Cincinnati, Ohio, in developing the gap turret lathe illustrated. This particular machine has all the regular dimensions of the 20-in. Cincinnati Acme turret lathe except that the gap provides for a maximum swing of 28 in. over the bed, the length of the gap from the end of the spindle being 9⅛ in. This machine has been equipped with an air chuck, also power feed to the cross cut-off slide travel and power feed to the longitudinal turret travel. The machine can also be furnished in any combination of hand and power feed that may be desired.

The primary purpose of the gap lathe is to provide a machine of large swing yet not requiring the proportions of a large lathe. There are many instances in which the use of a large lathe is necessary in order to swing the work, while the actual turning is on a small diameter. In the lathe illustrated it is possible to swing a wheel or piston up to 28 in. in diameter, whereas the actual work to be performed in facing and boring the hub or turning the piston rod is on a small diameter. There are quite a number of large jobs where there is no turning required on the outside diameter and only very small boring and facing near the center. For work of that character the gap turret lathe is especially adapted.

The lathe bed is cast with the gap, being reinforced with heavy ribbing underneath in order to maintain practically the same box section throughout and the same rigidity. The cut-off slide is provided with hand longitudinal and power cross feed obtained from the feed box shown in the front of the machine. The turret slide is also provided with power feed so that the boring and facing operations are both performed through power feed. The chucking and unchucking of the work is accomplished rapidly by means of the air chuck.



Acme Gap Turret Lathe with 28-In. Maximum Swing

General specifications of this machine are as follows: The minimum distance from the end of the spindle to the turret face is 14¾ in. and to the inside edge of the cross slide 8⅛ in. The feeds to the cross slides are 40, 70 and 120, those to the turret being 24, 43, 37 and 123. The cross movement of the cross slide is 7 in. and the lateral movement 4 in. The maximum distance from the inside of the cross slide to the end of the spindle is 12 in.

GENERAL NEWS

The Chicago, Burlington & Quincy will soon start using oil burning locomotives entirely on two divisions from Guernsey, Wyo., to Billings, Mont.

The shops of the Pennsylvania at Olean, N. Y., were damaged by fire on March 5; estimated total loss including some damage to 25 locomotives $100,000. The number of men at work in these shops was about 300.

Fire, of unknown origin, at the car shops of the Atchison, Topeka & Santa Fe, in Chicago (West Thirty-eighth street and South Central Park avenue), destroyed two freight cars on February 25. Estimated loss, including part of car repair shed, $65,000.

Representative Beck has introduced in the House of Representatives a bill authorizing the Interstate Commerce Commission to approve or disapprove contracts involving the construction or repair of locomotive engines, cars and maintenance work for railroads engaged in interstate commerce.

T. H. DAVIS, general chairman of the Association of Shop Craft Employees, Eastern Region, Pennsylvania Railroad, in a letter sent to all shop craft employees in his territory, says: "The railroad officials have many troublesome questions confronting them, but they have shown every disposition to try to strain a point in our favor when we were able to show them the justice of our claims; and, as co-operation is a two-sided thing, we feel that we ought to show our appreciation by helping them in every way we can. . . . What we need now is good business, to enable us to improve our conditions, and if every employee would just speak a good word for the old P. R. R., it would mean more business, and more business means more money to all of us. . . . It would be a very short time until the Pennsylvania could pay better wages and have better conditions than any other railroad in America." . . .

National Engineering Standards

The movement to develop national engineering standards sponsored by the American Engineering Standards Committee has made considerable progress during the past year. Among the standards approved during 1921 are a method of sampling coal, a safety code for the protection of the heads and eyes of industrial workers, specifications for steel automatic screw stock and specifications and tests for Portland cement. Standards before the committee at the close of the year included a national electrical safety code, specifications for car and locomotive forgings and a safety code for abrasive wheels. Numerous other projects of direct interest to railroads are now in the hands of committees.

Equipment Program of the St. Louis-San Francisco

THE ST. LOUIS-SAN FRANCISCO has authorized the expenditure of $7,766,000 in 1922 for new equipment, the repair and improvement of old equipment and other improvements; included in the amount is $1,260,000 for 8 steel coaches, 6 steel chair cars and a 150-ton steam derrick; $360,000, for rebuilding 250 steel coal cars; $300,000 for rebuilding 9 locomotives; $1,431,000 for bettering existing equipment; $205,000 for new power plants; $35,000 for new water treating plants; and $87,500 for improvement of coaches in branch line service. All mail and mail apartment cars are to be entirely rebuilt; baggage cars are to be improved; 7,000 freight cars rebuilt; 1,150 furniture and vehicle cars to be improved; and electric lights to be installed in coaches on branch lines and steel under-frames to be placed in all wooden coaches.

Locomotive Defect Chart

In July, 1920, the *Railway Mechanical Engineer* issued a chart showing the locomotive defects listed in the Interstate Commerce Commission's inspection rules. Many requests for additional copies of the chart have been received and it has been revised since the first publication and made more complete. Copies of the chart, twenty-two inches by thirty-four inches, printed on tough white paper, will be mailed to readers of the *Railway Mechanical Engineer* for the nominal sum of 15 cents to cover printing and mailing. Requests should be addressed to the circulation manager, Simmons-Boardman Publishing Company, Woolworth building, New York.

University of Illinois—Research Graduate Assistantships

The University of Illinois announces that there are 10 vacancies for the position of research graduate assistant in the Engineering Experimental Station and also one position for a man who wishes to specialize in gas engineering. These positions are open to graduates of approved American and foreign universities and technical schools who are prepared to undertake graduate study in engineering, physics and applied chemistry. Appointments are made for two consecutive years, at the expiration of which period, if requirements have been met, the degree of master of science will be conferred. Not more than half of the time of the assistant is required in connection with the work of the department, the remainder being available for graduate study. Research work and study may be undertaken in railway, mechanical, electrical or civil engineering and also in other branches.

Attached to the position is an annual stipend of $600 and freedom from fees except those in connection with matriculation. Additional information and application blanks can be obtained from the Director, Engineering Experimental Station, Urbana, Illinois.

The Government's Use of Jersey Central Locomotives

W. G. McAdoo, former director general of railroads, when making a recent statement before the Senate Committee at Washington quoted, with inferences unfavorable to the road, from a letter written by President W. G. Besler of the Central of New Jersey to the superintendent of motive power, directing the latter to have certain locomotives repaired as quickly as possible, so that a bill for the repairs could be presented to the government. Writing to the Newark Morning Ledger Mr. Besler replied to Mr. McAdoo in part, as follows:

"One side of the story is good until the other is told. Mr. McAdoo glibly states that the railroads, on return to private operation, endeavored to put through bills and charge them to the government, and he cites the Jersey Central as a particularly horrible example.

"Of course the railroads did so, for the reason that, under the contract, the government was obligated to return the properties in as good condition as when taken over, and when, as in the case of the Jersey Central, there were upwards of 100 engines disabled, worn out, and out of service, which should have been repaired by the director general, but which had been set aside and were not so repaired, why should not the railroads send such engines to engine builders for rebuilding, and to be placed in working condition? They had been worn out in 26 months of government operation, and had not been repaired. Is there anything improper in the thought that the government should repair them, or at least pay the bills on account of such repairs? These bills have not yet been paid! It is one of the claims against the government for failure in the matter of maintenance and upkeep which we hope and intend, if possible, to make the government pay, as required by its obligation in the contract."

Interpretation of Existing Standards for Freight Car Trucks

The Committee on Car Construction of the Mechanical Division of the American Railway Association has sent out the following circular, No. 176:

According to the votes by the members of the American Railway Association, all of the fundamentals in the recommendations made by the Committee on Car Construction at the June 1920, convention are now standard.

As it is very desirable that all new construction shall be uniform and in accord with these fundamentals, it is intended that new designs for truck side frames and bolsters, in fact for the complete truck, be made, but in order to provide the best that can be obtained some time will elapse. Until such designs have been prepared, and adopted as standard, it is recommended that for new construction and for replacements the truck side frames be made to conform with A. R. A. Sheet "B," as limiting dimensions, that the tension and compression members be U-section, and that the dimensions relating to trucks, which are given below, be adhered to:

	Inches
Height from rail to center of brake shoe	13
Height from rail to bottom of truck springs	10 3/4
Height from rail to brake beam hanger fulcrum	24 7/8
Height from rail to top of springs—empty car	18 3/4
Height from rail to center plate bearing surface	26 1/4
Height from rail to top of truck side bearings	27 5/8
Distance from center to center of side bearings	50

The use of either U. S. R. A. or A. R. A. standard bolsters is recommended, provided that such modifications in the shape are introduced that the truck heights as given in the foregoing are maintained. This involves making the vertical distance between center plate bearing surface and bolster spring bearing surface 8 in. The bolster sections should remain as before, or if slightly modified to provide sufficient clearance between bottom of bolster and spring plank, the section moduli should remain as before.

Purdue University's Experimental Locomotive

The Purdue testing locomotive, Schenectady No. 3, will soon be placed in the shops of the Monon railway at Lafayette, Ind., to undergo a general overhauling and receive the application of several new parts and economy devices. The placing of this locomotive (in 1897) in the locomotive laboratory at Purdue was primarily the result of the efforts of W. F. M. Goss, then Dean of the Schools of Engineering. Co-ordinating with Dean Goss in his efforts was the generous interest manifested by the Schenectady Locomotive Works and various other manufacturers, chief among which were the following: Bethlehem Steel Company, American Steel Casting Company, Ashton Valve Manufacturing Company, Detroit Lubricator Company, and the Keasby and Mattison Company. The product, known as Schenectady No. 2, was a saturated steam locomotive with a boiler designed to carry a pressure of 250 pounds per square inch.

In 1910 certain modifications, including new flue sheets, were made to provide for the application of a Schmidt superheater by the American Locomotive Company. The designation of the locomotive was then changed to Schenectady No. 3, the locomotive as it stands today in the locomotive laboratory.

The new work contemplates chiefly the application of new cylinders and outside valve gears. Donations toward this work have either been received or promised as follows: Baldwin Locomotive Works, new cylinders and piston valves, outside steam-pipes, pistons, crossheads and guides, main crank pins and Walschaert valve gear complete; Locomotive Firebox Company, thermic syphon; Sunbeam Electric Company, complete headlight and cab lighting equipment; Nathan Manufacturing Company, injectors, boiler checks and water glass; Locomotive Fuel Economizer Company, Boyce fuel economizer; and Southern Valve Gear Company, complete valve gear.

Plans for June Convention

Details of the annual meeting of the Mechanical Division of the American Railway Association to be held in Atlantic City, N. J., June 14 to 21, 1922, are now being formulated. The association has announced that the reports of committees investigating car matters will be received and discussed on Wednesday, Thursday and Friday, June 14 to 16, inclusive, and the reports of committees investigating locomotive matters on Monday, Tuesday and Wednesday, June 19 to 21, inclusive. A circular has been issued giving a list of hotels in Atlantic City and the rates.

Air Brake Convention Program

As previously announced, the annual convention of the Air Brake Association will be held at the Hotel Washington, Washington, D. C., May 9, 10, 11, and 12, 1922. In addition to accommodations, headquarters and convention hall at the Hotel Washington, provision has been made by the Committee of Arrangements for further accommodations of members at the new Ebbitt Hotel in the adjoining block.

The complete program is not yet available. The following papers will, however, be presented for discussion:

Recommended Practice; Committee report, H. A. Clark, chairman.

Air Consumption of Locomotive Auxiliary Devices; Committee report, C. H. Weaver, chairman.

Recent Tests of Steam Heating Apparatus; C. W. Hunter, Montreal Air Brake Club.

Terminal Tests to Insure Effective Grade and Operative Brake; Pittsburgh Air Brake Club.

Triple Valve Repairs; Northwest Air Brake Club.

Brake Pipe Vent Valves; W. W. White, Central Air Brake Club.

Schedule "UC" Brake Equipment; J. C. McCune.

International Railway Congress

The Ninth Congress of the International Railway Association will be held in Rome, Italy, from April 18 to April 30. Besides the meetings of the five sections into which the Congress is divided the program includes the following: Banquet by the Italian government April 19; reception at the Capitole April 21; excursion to the Terni Hydro-Electric Works and various establishments April 22; excursion to Naples and Pompeii April 29 and 30; departure from Genoa on May 1, and excursion to the electric traction installations in special train to Modane.

The sections of the Congress are as follows: 1. Way and Works; 2. Locomotives and Rolling Stock; 3. Operation; 4. General; 5. Light Railways.

The following who have been appointed as delegates of the American Railway Association have arranged to attend the Congress: L. A. Downs, chairman, Division IV—Engineering (vice-president and general manager, Central of Georgia Railway); D. Z. Dunott, chairman, Medical and Surgical Section (chief surgeon, Western Maryland Railway); J. E. Fairbanks, general secretary; T. De Witt Cuyler, chairman, Association of Railway Executives; W. W. Atterbury, vice-president, Pennsylvania; George Gibbs, chief engineer electric traction, Long Island; W. J. Tollerton, general mechanical superintendent, Chicago, Rock Island & Pacific.

The following who have been appointed reporters for the American Railway Association on the subjects indicated also will attend: W. J. Tollerton, chairman, Mechanical Division, A. R. A. (general mechanical superintendent, Chicago, Rock Island & Pacific Railway); "Passenger Carriages," Earl Stimson, chief engineer, Maintenance of Way, Baltimore & Ohio Railroad, "Maintenance and Supervision of the Track;" Samuel O. Dunn, editor of the Railway Age, "Net Cost Rates."

The following will go as delegates of their respective railways: Delaware & Hudson, W. H. Williams, vice-president; Illinois Central, A. S. Baldwin, vice-president, Hugh Pattison, electrical engineer, Donald Rose, European traffic manager; Lehigh & New England, William Jay Turner, vice-president and general counsel; Rollin H. Wilbur, vice-president and general manager, Henry H. Pease, secretary and treasurer; Long Island, Ralph Peters, president, George Gibbs, chief engineer electric traction; Pennsylvania System, J. V. B. Duer, electrical engineer, W. B. Wood, general superintendent, Illinois division; R. C. Morse, Jr., superintendent freight transportation, Eastern region, J. O. Hackenburg, superintendent, Schuylkill division; Philadelphia & Reading, A. T. Dice, president, F. M. Falck, general manager; Pittsburgh, Shawmut & Northern, H. S. Hastings, receiver.

George Gibbs is the American reporter on "Electric Traction." A. S. Baldwin on "Terminal Stations for Passengers," W. H. Williams on "Slow Freight Traffic."

Besides those mentioned above, the following American railway men have prepared reports: C. H. Ewing, vice-president, Phila-

delphia & Reading, "Construction of the Roadbed and of the Track;" W. C. Cushing, engineer standards, Pennsylvania System, "Special Steels;" G. A. Haggender, bridge engineer, Chicago, Burlington & Quincy, "Reinforced Concrete;" Howard G. Kelley, president Grand Trunk Railway, "Freight Stations." C. W. Crawford, chairman, General Committee, Section 5—Transportation, American Railway Association, "Interchange of Rolling Stock;" A. F. Banks, president, Elgin Joliet & Eastern, "Workmen's Dwellings;" H. B. Spencer, former director of purchases, United States Railroad Administration, "Special Methods of Traction on Light Railways."

The headquarters of the American delegates will be at the Grand Hotel, a short distance from the Fine Arts Exposition Palace in which the sessions of the Congress will be held.

Labor Board to Investigate Erie's Contract with Meadville Company

The Labor Board has ordered a thorough investigation of a contract for shop work which the Erie has made since the subject of contract work came before the Board and has authorized a member of the Board to make an investigation and "invoke the aid and counsel of the Department of Justice." The resolution ordering this investigation specifically mentions the contract made recently with the Meadville Machinery Company for the operation of the Erie's shops at Meadville, Pa., and says in part:

"Since the hearing (of the contract cases, reported recently in the Railway Age) information has come to the Board that the Erie without awaiting the decision of the Board upon said contract cases has entered into a further contract by virtue of which all the shops of the entire Erie system, including those involved in the above cases, have been contracted to a newly incorporated company called the Meadville Machinery Company. Public announcement has been made of the fact that the officers of the Meadville Machinery Company are the recent officers of the Erie.

"The principal question involved in the above cases is whether or not the employees of the companies to which certain shops had been contracted are in law and in fact the employees of the Erie and therefore still subject to the rules, working conditions and wages established by the order of this Board.

"Said employees having now been shifted a second time before the Board had rendered its decision in said pending cases and said contract system having been extended so as to embrace all other shops on the road it becomes the duty of the road upon its own motion to investigate the facts surrounding this alleged contract of the carrier with the Meadville Machinery Company.

"The Board therefore orders: 1—That the contract cases be reopened for the purpose of taking additional proof as to the issues involved in said cases; 2—That a thorough investigation be made of all the facts and circumstances surrounding said alleged contract and the operations being conducted thereunder; 3—That a member of this Board accompanied by such expert and stenographic assistance as may be deemed necessary be authorized and directed to go on the property of said carrier to conduct said investigation and to institute such legal proceedings as may be deemed necessary to effectuate this order after having first secured all the information possible here in Chicago; 4—That the member of the Board conducting said investigation be and is hereby authorized to invoke the aid and counsel of the Department of Justice at Washington if he deems advisable."

Labor Board Decisions

REPRESENTATION OF MECHANICAL SUPERVISORY FORCES TO BE DETERMINED BY BALLOT.—On May 4, 1921, a communication was addressed to A. P. Titus, general manager of the Chicago & Alton, by a committee representing the International Association of Railroad Supervisors of Mechanics requesting a conference for the purpose of negotiating rules and working conditions in accordance with the provisions of Decision No. 119. The carrier maintained that the organization did not represent a majority of the subordinate officials as designated by the Interstate Commerce Commission, and the organization submitted the question to the Labor Board, filing a petition bearing the signatures of 90 foremen, authorizing it to represent them in agreement negotiations. The carrier also made a canvass of the foremen and 98 men, or 76 per cent of the supervisors of mechanics in the maintenance of way, locomotive and car departments signed a petition signifying their desire either to deal with the company direct or through a committee named in the petition. The organization took exception to the method followed by the carrier in canvassing the foremen. The board has decided that the method followed by both parties was inconsistent with the intent of Decision No. 119 and that a conference shall be held between representatives of the carrier, of the International Association of Railroad Supervisors of Mechanics, of any other organization representing mechanical foremen, and of 100 or more unorganized employees, for the purpose of arriving at a clear understanding as to the details of taking a ballot by which the foremen, by a majority vote, may designate their choice of representation. Separate forms of ballots for the foremen in the mechanical and bridge and building departments are specified.—*Decision No. 629.*

FOREMEN NEED NOT BE EMPLOYED FOR THE FULL TIME LABORERS ARE AT WORK.—A case was presented to the Labor Board with respect to the question of employing a coal chute foreman for a less number of hours and days than the laborers he supervised. Evidence shows that he was employed with a gang of laborers for 365 days a year and ten hours a day. On March 6, 1920, he was instructed to work only on week days and nine hours a day, the laborers continuing on the old schedule. The United Brotherhood of Maintenance of Way Employees and Railway Shop Laborers contended that in Supplement No. 8 to General Order No. 27 no change in hours was authorized and that the foreman must be permitted to work the same number of hours as the men. The carrier contended that this provision of Supplement No. 8 was canceled by the National Agreement with the Brotherhood and that there is nothing in this agreement which requires the carriers to employ a man in excess of eight hours on regular week days, if his services are not required. The contention of the carrier was sustained.—*Decision No. 713.*

CLASSIFICATION OF CHAUFFEUR AS MECHANIC DENIED.—A chauffeur employed by the maintenance of way department of the Terminal Railroad of St. Louis, to operate a truck used to transport maintenance materials, asked for a reclassification as a mechanic, because he made minor repairs on the truck, the railroad having applied increases and decreases in accordance with Order No. 2 and No. 147 respectively on the basis of "laborer employed in and around shops and roundhouses." The claim for reclassification as a mechanic was denied.—*Decision No. 711.*

BASIS OF MONTHLY RATE FOR TRACK AND SHOP LABORERS.—An engine watchman was, on January 1, 1918, paid the rate of $67.50 a month. On September 1, 1918, the effective date of Supplement No. 7 to General Order No. 27, an hourly rate of 38¾ cents was established and it remained in effect up to March 1, 1920, when it was changed to a monthly rate of $145 a month, in accordance with Section a-12, Article V of agreement between the Director General of Railroads and the United Brotherhood of Maintenance of Way Employees and Railway Shop Laborers. This rate was increased to $165.40 a month on May 1, 1920, the effective date of Decision No. 2 of the Labor Board, and was reduced July 1, 1921, to $145 in accordance with Decision No. 147 of the Labor Board.

The employees contended that the watchman should have received a monthly rate of $189.64, under Decision No. 2 of the Labor Board, on the claim that he worked 12 hours each night, 365 nights a year at straight time for 10 hours 365 days a year, and two hours' overtime for 365 days plus 12 hours' overtime for 52 Sundays. The carrier maintained that the actual time put in by this employee and the amount allowed on the hourly basis from August 31, 1918, was slightly less than $145 a month, and that when the national agreement of the maintenance of way employees, effective December 16, 1919, was received the employee was placed on a monthly rate of $145, predicated on the average earnings on the hourly basis; that, effective with Decision No. 2 of the Labor Board, the position was increased to $165.40 a month, and was again reduced to $145 under the provisions of Decision No. 147 of the Labor Board.

The Labor Board decided that under Section a-12, Article V, of the United Brotherhood of Maintenance of Way Employees and Railway Shop Laborers' agreement, the monthly rate should be predicated on the hours for which payment was allowed, when rated on the hourly basis.—*Decision No. 714.*

Freight Car Orders

THE GREAT NORTHERN has ordered 500 refrigerator cars from the General American Car Company; also 500 all steel gondola cars from the Pressed Steel Car Company, and 500 stock cars from the Pullman Company.

THE CHICAGO, BURLINGTON & QUINCY has ordered 500 automobile cars from the Pullman Company.

THE FRUIT GROWERS EXPRESS is building 100 refrigerating cars in its shops at Alexandria, Va.

THE PACIFIC FRUIT EXPRESS has ordered 700 refrigerator cars from the General American Car Company in addition to the 2,600 cars ordered from the Standard Steel Car Company as noted in the March issue.

THE NORFOLK & WESTERN has ordered 1,000 cars from the Standard Steel Car Company, 1,000 from the American Car and Foundry Company, and 2,000 from the Pressed Steel Car Company.

THE ATLANTIC COAST LLNE has ordered 450 steel underframes and superstructures from the Pressed Steel Car Comuany and 50 from the Chickasaw Shipbuilding Corporation. These are for box cars to be rebuilt in the railroad company's shops.

THE UNITED FRUIT COMPANY, New York, has ordered 25 ballast cars of 30 tons capacity from the Magor Car Company for export to Honduras.

THE WESTMORELAND COAL COMPANY has ordered 100 55-ton hopper cars from the Cambria Steel Company.

THE TENNESSEE COAL, IRON & RAILROAD COMPANY has ordered 150 ore dump cars from the Chickasaw Shipbuilding Company.

THE NEW YORK CENTRAL has ordered 250 steel underframe, double sheathed box cars of 40 tons capacity from the American Car & Foundry Company and has equally divided an order for 750 steel hopper cars of 55 tons capacity between the Pressed Steel Car Company, the Standard Steel Car Company and the Pullman Company.

Freight Car Repairs

THE DELAWARE, LACKAWANNA & WESTERN has given an order to the American Car & Foundry Company for the repair of 985 steel hopper cars, of 40 tons capacity.

THE GULF, MOBILE & NORTHERN is having repairs made to 100 steel underframe box cars, at the shops of the Anniston Electric Steel Corporation, Anniston, Ala.

THE NEW YORK CENTRAL is placing contracts for the repair of a large number of freight cars, including 300 cars to the Ryan Car Company; and a number to the Streator Car Company, the Buffalo Steel Car Company and the Euclid Steel Car Company, for the Michigan Central; also 500 to the Ralston Steel Car Company for the Toledo & Ohio Central. All the cars for repair are steel gondola and hopper cars.

Passenger Car Orders

THE CENTRAL OF NEW JERSEY has placed orders for a total of 70 cars as follows: 20 coaches and 10 combination passenger and baggage cars to the American Car & Foundry Company, 30 coaches to the Standard Steel Car Company and 10 baggage cars to the Bethlehem Shipbuilding Corporation, Harland Plant.

THE SOUTHERN PACIFIC has ordered 50 steel cars for service on its Pacific Electric division from the St. Louis Car Company, the electrical equipment to be furnished by the Westinghouse Electric & Manufacturing Company.

Locomotive Orders

THE CHICAGO, BURLINGTON & QUINCY has ordered 47 Mikado, Santa Fe and Pacific type locomotives from the Baldwin Locomotive Works and 8 Mountain type from the Lima Locomotive Works.

Locomotive Repairs

THE SOUTHERN RAILWAY is rebuilding 25 consolidation type and 20 Pacific type locomotives in its own shops. These locomotives will be equipped with superheaters and Chambers throttle valves. Outside valve gear will be added to the locomotives not yet equipped with this device.

Shop Construction

GREAT NORTHERN.—This company has awarded a contract for the construction of a 30-stall roundhouse, shop buildings, storehouses and other terminal facilities at Minneapolis Junction, Minn., to A. Guthrie & Co., St. Paul.

ATCHISON, TOPEKA & SANTA FE.—This company, which has four small store department buildings at Topeka, Kan., estimated to cost $15,000.

ATCHISON, TOPEKA & SANTA FE.—This company, which has been contemplating the construction of extensions and improvements to its machine shops at San Bernardino, Cal., the work to include a one-story building 65 ft. by 510 ft., equipped with machinery and cranes, of which the entire cost is estimated at $250,000, has awarded the contract for this work to C. A. Fellows, Los Angeles, Cal.

TEXAS & PACIFIC.—This company is constructing a three-story building at Marshall, Texas, to be used by its apprentices for their instruction and study of car and locomotive work.

GULF & SHIP ISLAND.—This company is constructing a new engine house 105 ft. by 220 ft., and a new machine shop of steel frame and brick construction, 75 ft. by 200 ft., to replace property destroyed by fire on February 25, of which a loss was estimated at $75,000

Meetings and Conventions

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Annual convention May 9, 10, 11 and 12, Hotel Washington, Washington, D. C.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next annual convention June 14 to 21, 1922, Atlantic City, N. J.

DIVISION V—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.

DIVISION VI—PURCHASE AND STORES.—J. P. Murphy, N. Y. C., Collinwood, Ohio. Meeting June 19, 20 and 21, Atlantic City.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York, Railroad Division, A. F. Stuebing, 2201 Woolworth Building, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention and exposition postponed until October 2-7, 1922, Detroit, Mich.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Regular meeting second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, New Morrison Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo. Meetings first Tuesday in month except June, July and August, at the American Hotel Annex, St. Louis, Mo.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio.

DIXIE AIR BRAKE CLUB.—E. F. O'Connor, 10 West Grace St., Richmond, Va.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Convention Hotel Sherman, Chicago, August 15, 16 and 17.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 702 East Fifty-first St., Chicago, Ill. Next annual meeting Auditorium Hotel, Chicago, May 22 to 25, 1922.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Next annual convention Hotel Sherman, Chicago, May 23 to 26, 1922.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Annual entertainment and banquet at Copley-Plaza Hotel, Boston, April 11.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meetings fourth Thursday in each month, except June, July and August, at Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Next meeting April 14. Paper on the Railroad Situation will be presented by Z. G. Hopkins, assistant to the operating officer, Missouri, Kansas and Texas. Annual election.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, Marine Trust Building, Buffalo, N. Y.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 14 E. Jackson Boulevard, Chicago. Regular meetings third Monday in each month, except June, July and August. Next meeting April 17. Paper on Locomotive Types from a Transportation Viewpoint, to be presented by J. F. Porterfield, general superintendent of transportation, Illinois Central. Annual meeting and dinner at the Drake hotel, May 15.

PERSONAL MENTION

GENERAL

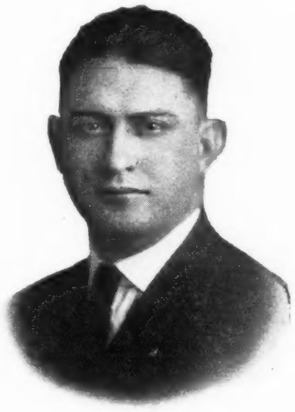
F. S. BROWN, mechanical engineer of the Erie, with headquarters at Meadville, Pa., has been appointed chief mechanical engineer with headquarters at New York and G. T. Dupue has been appointed mechanical superintendent of the Ohio and Chicago regions, with headquarters at Youngstown, Ohio, to succeed Charles James. Winfield S. Haynes, formerly master mechanic, with headquarters at Dunmore, Pa., has been appointed superintendent of shop operation with headquarters at New York. He will report directly to the general manager.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

GEORGE E. LUND has been appointed master mechanic of the Mahoning division of the Erie with headquarters at Youngstown, Ohio.

D. J. DURRELL is master mechanic of the Pennsylvania Railroad at Cincinnati, Ohio. Mr. Durrell has not been transferred to Lancaster, Ohio, succeeding R. J. Sponseller, as inadvertently announced in the March issue of the *Railway Mechanical Engineer*.

WALTER L. BARR has been appointed master mechanic of the Kent and Cincinnati Divisions of the Erie Railroad with headquarters at Marion, Ohio. Mr. Barr was born at Quachita, La., on September 26, 1888, and graduated from the Louisiana Polytechnic Institute in 1911. He entered the employ of the Erie Railroad on June 26, 1912, as a special apprentice at Dunmore, Pa. On November 4, 1915, he was transferred to Port Jervis, N. Y., as an apprentice instructor and in November of the following year was appointed roundhouse foreman. From November, 1917, until October 24, 1918, he was night general foreman at Port Jervis and from the latter date until his appointment as noted above, was day general foreman of the shops at Meadville, Pa.



W. L. Barr

C. M. STARKE has been promoted to master mechanic of the Illinois Central with headquarters at Centralia, Ill., succeeding J. W. Branton, deceased. Mr. Starke entered the employ of the Illinois Central on April 18, 1891. From April, 1893, to April, 1897, he was a machinist apprentice and from April, 1897, until September, 1901, a machinist and gang foreman. He then became night roundhouse foreman at Water Valley, Miss., and in June, 1902, was appointed day roundhouse foreman. In 1905 he was made erecting shop foreman; in 1909 was transferred to the Indianapolis Southern as a general foreman at Indianapolis, Ind., and from September, 1911, until September, 1912, was general foreman at Champaign, Ill. He was then appointed master machanic of the Mississippi Division with headquarters at Water Valley and from June, 1913, to November, 1917, was master mechanic of the Louisiana Division at McComb, Miss. Resigning from this position, he became superintendent of motive power of the Missouri, Kansas & Texas, later becoming supervisor of locomotive maintenance in the Allegheney Region of the United States Railroad Administration at Philadelphia, Pa. On March 1, 1920, he returned to the Illinois Central and was assigned special duties in the office of the general superintendent of motive power.

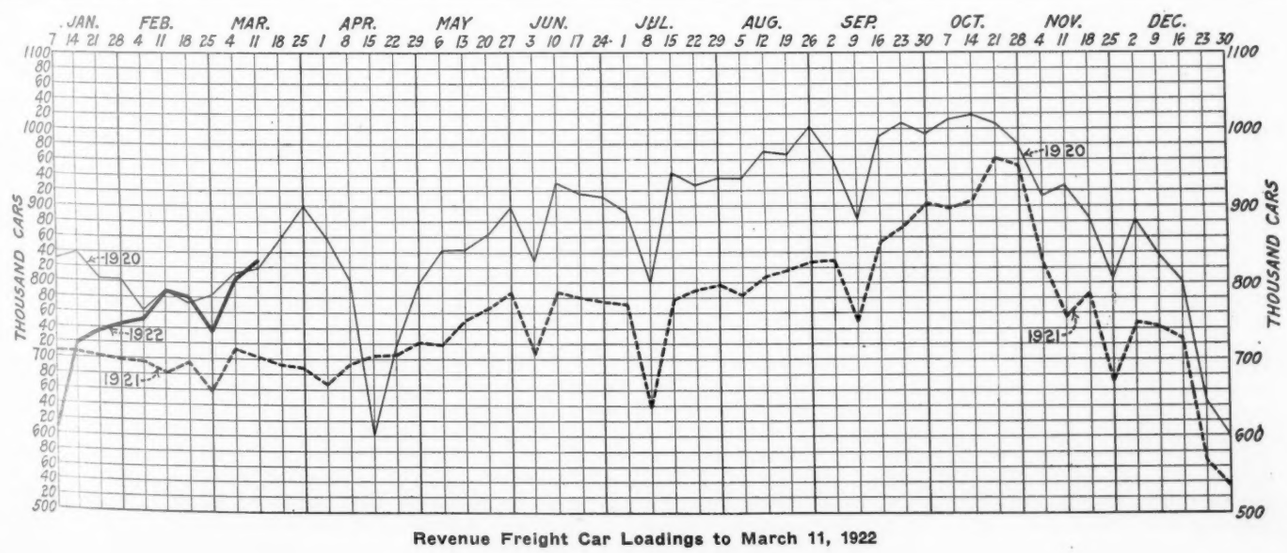
PURCHASING AND STORES

A. J. MELLO has been appointed purchasing agent of the San Diego & Arizona, with headquarters at San Diego, Cal., succeeding S. P. Howard, resigned.

C. C. KYLE, acting general storekeeper of the Northern Pacific, with headquarters at St. Paul, Minn., has been promoted to general storekeeper with the same headquarters, succeeding O. C. Wakefield, deceased.

D. V. FRASER has been appointed assistant to the purchasing agent of the Missouri, Kansas & Texas, with headquarters at St. Louis, Mo., succeeding H. H. Kahrs, resigned to enter other businesss.

EDWIN H. GAINES, JR., whose appointment as purchasing agent of the Tennessee Central, with headquarters at Nashville, Tenn., was announced in the March *Railway Mechanical Engineer*, was born at Nashville, on November 8, 1887. He entered railway service in September, 1905, as a file clerk in the passenger traffic department of the Nashville, Chattanooga & St. Louis at Nashville, and was successively chief file clerk, secretary to the chief clerk and advertising agent in the above named department of that road until February 1, 1909, when he left to become associated with the Charleston Mining & Manufacturing Company. He entered the service of the Tennessee Central at Nashville in July, 1913, since which time he has been invoice clerk in the receivers' office, secretary to the receivers, secretary and chief clerk to the general superintendent, and chief clerk to the receivers, which latter position he was holding at the time of his recent promotion to the position of purchasing agent.



Revenue Freight Car Loadings to March 11, 1922

SUPPLY TRADE NOTES

J. W. McCabe, of the Chicago Pneumatic Tool Company, New York, has returned from a three years' tour aound the world.

The Ryan Car Company has increased its capital stock from $2,500,000 to $6,000,000, by the issuance of 35,000 shares of additional common stock with a par value of $100 per share.

The United States Cast Iron Pipe & Foundry Company, Burlington, N. J., has opened a new office in the Interstate building, Kansas City, Mo., in charge of D. W. Pratt, sales agent.

The Stowell Company, South Milwaukee, Wis., has moved its Chicago office from 509 Monadnock Block to 628 McCormick building. E. B. Hansen will continue as manager of the Chicago office.

The United Alloy Steel Corporation, Canton, Ohio, announces that John McConnell, who was formerly in the service of the corporation has again entered its service as vice-president, in charge of operation.

The O'Fallon Railroad Supply Company, Arcade building, St. Louis, Mo., has been appointed sales agent for the Standard Railway Equipment Company, and the Union Metal Products Company for the St. Louis district.

Stewart J. Dewey, assistant signal engineer of the Cleveland, Cincinnati, Chicago & St. Louis, has resigned to enter the service of the Electric Storage Battery Company, Philadelphia, Pa., in the railway signal department of its Chicago branch

Pendleton E. Lehde has been appointed a special representative in the State of Louisiana and the southern part of Mississippi of the Roller-Smith Company, New York City. Mr. Lehde's headquarters are at 609 Whitney central building, New Orleans, La.

Ross E. Willis, formerly sales engineer of the Lakewood Engineering Company, Cleveland, Ohio, in the southern Michigan territory, has become associated with William F. V. Newmann & Sons. Detroit, Mich., representing the Baker R. & L. Company in the Detroit territory.

Don H. Amsbary, Pittsburgh district manager of the Dearborn Chemical Company, Chicago, died on January 25 at his home in Pittsburgh, Pa. Mr. Amsbary was born on March 3, 1869, at Pekin, Ill. In 1907 he entered the employ of the Dearborn Chemical Company, in the Pittsburgh district, and for the past seven years was district manager of that company.

C. R. Naylor, of the western sales office of the T. H. Symington Company, at Chicago, has been appointed manager of sales of the Forged Steel Yoke Corporation, with headquarters in the Peoples Gas building, Chicago. The output of the Forged Steel Yoke Corporation will be sold and distributed by the T. H. Symington Company, which still retains Mr. Naylor's services.

William C. Sargent for 22 years secretary and also a director of the Chain Belt Company, Milwaukee, Wis., died on February 5. Mr. Sargent was born at Troy, N. Y., on February 2, 1849. In 1871 he went to St. Paul, Minn., and in 1900 became secretary and later a director of the Chain Belt Company, Milwaukee. He was also a director of the Federal Malleable Company, West Allis, Wis.

William Boughton, district representative at Detroit, Mich., of the Superheater Company, New York city, died at his home in Detroit on March 8, of heart disease. Mr. Boughton was born in Ontario county, New York, in 1861. He went to Saginaw, Mich., in 1876, and a year later began his railroad career with the Pere Marquette as a machinist apprentice. Two years later he was advanced to brakeman, later to fireman, and in 1882 to engineman. In 1898, Mr. Boughton was promoted to road foreman of engines, and seven years later he was appointed master mechanic of the Saginaw division. In 1909 he became general master mechanic of the entire system and later was promoted to superintendent of motive power. He resigned from the service of the Pere Marquette in 1912 to become district representative at Detroit of the Superheater Company, New York city, which position he held at the time of his death.

A. W. Brown has been appointed assistant to the vice-president of the western district of the T. H. Symington Company, New York City. Mr. Brown will make his headquarters in the Peoples Gas building, Chicago. He was born on February 6, 1881, in New York City, and was educated at Trinity College of New York and Andover Academy of Mass. Mr. Brown was connected with the Griffin Wheel Company from 1913 to 1919 and was then appointed manager of railway sales of the Air Reduction Sales Company, New York City, which position he now leaves to take up his new duties with the T. H. Symington Company.

The Combustion Engineering Corporation, New York, has opened its own office in the First National Bank building, Pittsburgh, Pa., and will soon open an office in Cleveland, Ohio, both of which will be in charge of W. C. Stripe, former manager of the Philadelphia office, arrangements having been made between this corporation and the George J. Hagan Company of Pittsburgh, whereby the Hagan Company discontinues representation of the Combustion Engineering Corporation. The Hagan Company will retain the exclusive agency for the type H stoker, formerly known as the American stoker, for use in industrial furnaces.

C. W. Holt, secretary and general manager of the Curtain Supply Company, Chicago, has been elected a vice-president in charge of all operations of the company; Ross F. Hayes, eastern sales manager, with headquarters at New York City, has been appointed general sales manager, with headquarters at Chicago; T. P. O'Brien has been appointed district sales manager, in charge of the eastern office at New York City, and Ralph Brown has been appointed district sales manager of the western district with headquarters at Chicago; G. B. Allison has been appointed assistant to Mr. O'Brien and Edward E. Whitmore assistant to Mr. Brown.

William A. Barstow, president of the Union Tank Car Company, New York, died at his home, Hutton Park, West Orange, N. J., on February 10. Mr. Barstow was born on September 27, 1877, at Cleveland, Ohio, and was educated at the Dearborn Morgan School, Orange, N. J., and at Yale University, graduating from the latter in 1899. The same year he entered the employ of the Atlantic Refining Company at Franklin, Pa. He subsequently served in many branches of the oil industry and in October, 1914, resigned as vice-president of the Imperial Oil Company at New York to become assistant to president of the Union Tank Car Company. Later he was promoted to senior vice-president and since 1919 served as president of the same company.

The Whiting Corporation, Harvey, Ill., has established its own branch sales office in New York City at 136 Liberty street, having discontinued its agency agreement with the Wonham, Bates & Goode Trading Corporation, New York City, who formerly represented the Whiting corporation in the East. J. Ross Bates, now a vice-president of the Whiting Corp., is in charge of the new office and will be assisted in the New York territory by D. Polderman, Jr. In the New England states he will be assisted by R. C. Maley, who will open an office at Springfield, Mass. All of these men were formerly associated with the Wonham, Bates & Goode Trading Corporation. The Whiting corporation has opened a branch office in Indianapolis, Ind., 305 Merchants Bank building, in charge of S. E. Stout, formerly at the main office, in Harvey. Mr. Stout will cover southern Indiana and adjoining cities in Ohio and Kentucky. The corporation's Detroit office has been moved from Penobscot building to 206 Stahelin building, 3000 Grand River avenue.

Merger of Machine Tool Manufacturers

Negotiations to merge a number of machine tool manufacturers are said to have been completed, according to recent announcement. The name of the new corporation has not yet been decided upon. The companies included in the merger are the Lodge & Shipley Machine Tool Company, Carlton Machine Tool Company, Newton Machine Tool Works, Inc., Betts Machine Company, Colburn Machine Tool Company, Hilles & Jones Company, Modern Tool Company, and the Dale Machinery Company.

John D. Ristine, manager of sales of the Chicago Crucible Company, has been appointed manager of sales of the railroad division of the Service Motor Truck Company, Wabash, Ind. Mr. Ristine has been with the Chicago Crucible Company for the past two years. Previous to that time he served as assistant to G. B. Robins, vice-president of Armour & Co., before which he was engaged in railway supply work, having been at one time secretary of the Union Draft Gear Company.

The Warren Tool & Forge Company, Warren, Ohio, has purchased the American Block & Manufacturing Company and the General Malleable Company, both of the same city. The American company manufactures malleable unions with bronze inserted seats, for the production of which the plant has a capacity of about 250,000 per month. The General Malleable Company manufactures malleable castings, a large proportion of which are used by the railroads and the total capacity for the production of which is about 600 tons per month. These companies will henceforth be operated as a part of the Warren Company, the capitalization of which under the merger is $1,800,000. The company will continue to operate under the present management.

Ross F. Hayes has been appointed general sales manager of the Curtain Supply Company, Chicago. Mr. Hayes was born at Lewiston, Me. He entered business with the Boston Woven Hose & Rubber Company in 1888, and was in the service of that company for 16 years, during which time he served as salesman in the rubber goods department in New England and New York state and in 1893 was transferred as city sales manager to St. Louis, Mo. After two years' service at that point, he was appointed New England representative of the mechanical rubber goods department and two years later manager of the Philadelphia office, where he remained until 1904. During the latter year he entered the service of the Curtain Supply Company as western representative and since 1907 has served as eastern sales manager with headquarters at New York.

R. F. Hayes

E. S. Fitzsimmons has been appointed manager of sales of the Flannery Bolt Company, Pittsburgh, Pa. He was born on April 12, 1876, at Columbus, Ohio. He served his apprenticeship with the Chicago, Rock Island & Pacific at Horton, Kan., leaving that company in 1899 to become foreman boilermaker with the Delaware, Lackawanna & Western at Scranton, Pa. In 1904 he served as general boiler inspector of the New York, New Haven & Hartford and from 1905 to 1907 as general foreman boilermaker of the Erie. He was then promoted to master mechanic at Galion, Ohio, and in 1908 was transferred as master mechanic to Hornell, N. Y., which position he held until 1912, when he was promoted to mechanical superintendent Erie, Lines West. In 1914 he was transferred to New York as mechanical superintendent of the Erie, Lines East, resigning in 1918 to become works manager for the McCord Manufacturing Company, Detroit, Mich. Mr. Fitzsimmons entered the service of the Flannery Bolt Company at Pittsburgh as salesman in December, 1920, and now becomes manager of sales of the same company.

C. E. Skinner, manager of the research department of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has been appointed assistant director of engineering. His duties will cover research, standards and other work along these lines. Mr. Skinner was born near Redfield, Ohio, on May 30, 1865, and was graduated in 1890 from Ohio State University. The same year he joined the Westinghouse organization in the controller department, and supervised the construction of the first controller turned out by that company. Soon afterward he was placed in charge of the testing of insulation, and in 1892 he was transferred to the research laboratory. In 1895 he was placed in charge of insulation design in the engineering department, taking charge, in 1902, of the insulation division of that department, together with the chemical and physical laboratories. Four years later he organized the research division, of which he has been in charge until his present promotion. In 1915 he was a special representative of the American Institute of Electrical Engineers, of which he is a fellow, at the international conference on electrical standards held in London, and he is now a member of the committee representing the Institute of the International Electrotechnical Commission. He was chairman of the American delegates to the Brussels meetings in 1920.

Geo. W. Bender, whose appointment as vice-president of the Argyle Railway Supply Company, Chicago, was noted in the *Railway Mechanical Engineer* of March, was born at Pittsburgh, Pa., on August 20, 1884. Seventeen years later he entered the engineering department of the Pressed Steel Car Company, at Pittsburgh. In 1906 he entered the service of the American Locomotive Company, where he had charge of the extra work order department. He became associated with Mudge & Co., in 1910, as chief draftsman, and subsequently was placed in charge of the mechanical department. Later he was promoted to assistant to the vice-president and in April, 1918, was appointed eastern manager in the New England and Atlantic Coast states. In September, 1919, he was appointed manager of sales and service, with headquarters at Chicago, the position he occupied at the time he entered the service of the Argyle Railway Supply Company.

G. W. Bender

John P. Landreth has been elected president and treasurer of the Universal Packing and Service Company, Chicago. Mr. Landreth was born at Beloit, Kan., on August 11, 1883, and attended the public schools and a business college at Joplin, Mo., and later the Missouri Military Academy at Mexico, Mo. He entered business with the Joplin Water Works Company, Joplin, Mo., as a collector and inspector of accounts. Later he served as a car clerk on the Denver & Rio Grande at Salida, Colo., and, in 1902, became associated with the English Iron Works at Kansas City, later entering the railway specialty sales department of this company at St. Louis. In 1904 he became associated with the Garlock Packing Company as traveling salesman, and on January 1, 1905, was transferred to St. Louis as city salesman. One year later he was placed in charge of the Kansas City office of the company and in May, 1908, was made Chicago manager, which position he held until July, 1916. On the latter date he was appointed western sales manager of the Anchor Packing Company of Philadelphia, Pa., with headquarters at Chicago, which position he still retains in addition to his duties as president and treasurer of the Universal Packing and Service Company.

J. P. Landreth

George H. Green has been elected vice-president and secretary of the Universal Packing and Service Company. Mr. Green was born on December 19, 1886, at Chicago. He entered business in the testing department of the Chicago, Rock Island & Pacific in 1906 and during the succeeding eight years served as inspector and chief inspector of materials. In 1914, he was appointed railroad representative of the Garlock Packing Company, and two years later he entered the service of the National Waste Company as sales representative. During the war Mr. Green served as a lieutenant in the field artillery branch of the service and upon his return to this country entered the service of the National Waste Company. In 1919, he was elected vice-president of the company, which position he still retains in addition to his new duties with the Universal Packing and Service Company.

The Meadville Machinery Company, Incorporated, Meadville, Pa., has been organized. William Schlafge, mechanical manager of the Erie at New York has been elected president of the new company; Charles James, who was mechanical superintendent on the Ohio Region of the Erie at Youngstown, is vice-president and W. A. Cotton, of the office of the mechanical manager, is secretary and treasurer. The general offices will be at 50 Church street, New York City. The company was organized to operate the locomotive and car shops of the Erie at the following points: Stroudsburg, Pa., Dunmore, Pa., Avon, N. Y., Meadville, Pa., Galion, Ohio, and Dayton, Ohio; car shops only at Elmira, N. Y., and Marion, Ohio, and locomotive shops only at Cleveland, Ohio; Huntington, Ind., and Hammond, Ind.

OBITUARY

Otis H. Cutler, chairman of the board of directors of the American Brake Shoe & Foundry Company, New York, died at Miami, Florida, on March 4. Mr. Cutler was a well known figure in the railway supply field for many years. He was born in New York city and educated at the Rockland Military Academy, Nyack, N. Y., and the Washington Law University. He served as private secretary to Senator William P. Frye, of Maine, from 1884 to 1895 and for the following three years was a member of the New York State Assembly from Rockland county. He started his business career as secretary of the North River Bridge Company and later became manager of the Ramapo Iron Works. He was instrumental in forming the American Brake Shoe & Foundry Company, serving as its vice-president and general manager in 1902, and from 1903 to 1916 as president, when he resigned and became chairman of the board of directors, the position he held at the time of his death.

Otis H. Cutler

During the recent war Mr. Cutler volunteered his services to the American Red Cross and organized and was the first manager of its Insular and Foreign Division. For his work in this direction he was made a major. After the armistice he spent considerable time in Europe assisting in the organizing of the League of Red Cross Societies, headquarters of which are at Geneva, Switzerland.

Mr. Cutler was identified with large and important enterprises in the industrial and financial world, being associated with many of the J. P. Morgan undertakings and he was director in numerous corporations, including: The Railway Steel Spring Company; American Arch Company; Bronze Metal Company; American Manganese Steel Company; Manganese Steel Rail Company; Southern Wheel Company; American Malleables Company; Dominion Brake Shoe Company, Ltd., and New York Telephone Company. He was also a member of many clubs and societies.

TRADE PUBLICATIONS

Cranes.—A four-page, illustrated circular describing in a general way its complete line of cranes, also foundry equipment, short turn trolley systems, and hoists, has been issued by the Whiting Corporation, Harvey, Ill.

Circular Sawing Machines.—Bulletin No. 5 featuring several types of sawing machines and giving a number of practical pointers about circular saws and their care, has recently been issued by the Oliver Machinery Company, Grand Rapids, Mich.

Metallographic Equipments.—The Bausch & Lomb Optical Company, Rochester, N. Y., has recently issued a bulletin describing and illustrating its inverted style of microscope and three complete metallographic outfits in which it is embodied.

Automatic Driving Box Wedges.—The Franklin Railway Supply Company, New York, has issued a phantom view of the Franklin automatic adjustable driving box wedge showing the construction of the wedge and related parts and giving instructions for proper methods of lubrication.

Portable Electric Drills.—The Black & Decker Manufacturing Company, Baltimore, Md., has recently issued a miniature catalogue and price list of its portable electric drills, electric screw driver and socket wrench, electric grinders, safety cleaning machine and electric valve grinder.

Locomotive Repairs.—How milling has become a means of reducing costs on many machining operations in railroad shops is the subject covered in the 32-page illustrated catalogue recently issued by the Cincinnati Milling Machine Company, Cincinnati, Ohio. Specifications, a description of the operation of Cincinnati millers, and a list of locomotive parts which should be milled are also included in this catalogue.

The Shepard Electric Liftabout.—The Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., has recently issued a small illustrated folder descriptive of a new and smaller type of electric hoist, manufactured by that company. The text and illustrations show a wide number of purposes for which this hoist can be utilized to advantage such as the loading and unloading of freight, the shifting or storing away of material in storehouses, etc.

Cutting Torch.—A leaflet fully describing the various features of design and construction of the Airco "D" cutting torch has been issued by the Air Reduction Sales Company, New York. Sectional views of the torch are shown and tables given showing the thickness of metals that can be cut, the pressures of oxygen and acetylene necessary, and the gas consumption in cubic feet per hour when using tips adapted to the cutting of steel, cast iron or rivets.

Oil Burners.—A 32-page illustrated booklet has been published by the Denver Fire Clay Co., Denver, Colo., in which oil burners are described and illustrated. According to the foreword of the booklet, the purpose of the catalogue is to aid in the selection of fuel and oil burning equipment by describing what has been found through experiments, much study and competition to be the best methods of burning liquid fuel. Complete description and specifications are given.

Centrifugal Pumps.—Much valuable data regarding centrifugal pumps is contained in Bulletin W605 published by the Worthington Pump & Machinery Corporation, New York. The bulletin is, in reality, a handbook for operating engineers and covers thoroughly the question of installation, operation and maintenance of centrifugal pumps. One of the features of the book is a curve showing the maximum water temperature allowable for varying suction lifts which, it is stated, has never been printed before. Curves are also included to show the head capacity and efficiency capacity characteristics of centrifugal pumps. The concluding pages contain a large amount of valuable tabular matter to facilitate the solution of pumping problems.